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ABSTRACT

The 25 projects described were concerned primarily with educational applications of communications satellites, although some projects in additional public services--health, community development, and administration--were included in the Hermes satellite program. Solicited by the Department of Communications (DOC) from agencies and organizations across Canada, these projects were selected from the 49 proposals originally submitted. Experiments which were approved were allocated portions of satellite time for conducting their projects. Evaluation of the public service sector projects was a major DOC priority. Each project had an evaluation plan and an external team contracted to prepare a general evaluation design and assess the overall significance of the educational experiments with respect to future uses of satellite telecommunications technology. The Hermes communications technology satellite was made in Canada and launched in the United States, representing a joint venture between the two countries. The Hermes educational projects stimulated considerable interest in educational applications of telecommunications satellite technology, and raised numerous questions regarding its effective and efficient use. The evaluations conducted provide initial information, but no definitive answers. (Author/JEG)

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EVALUATION OF THE EDUCATIONAL EXPERIMENTS ON THE HERMES SATELLITE 1976-77

FINAL REPORT

by

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and
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Evaluating the Hermes experiments has been a fascinating and rewarding experience which, over a period of several years, has given us the privilege of working closely with many agencies and institutions and with a host of dedicated and dynamic individuals across Canada. We are grateful to all of them for their contribution to our attempt to evaluate the Hermes project and to draw lessons from it for the future.

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Edmonton, Alberta
February 1979

J. Murray Richmond
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TABLE OF CONTENTS

Acknowledgements i

SECTION 1 Introduction 1

SECTION 2 Evaluation Summary of the Hermes Educational Experiments 3

2.1 The Evaluation Context 4

2.2 The Evaluation Plan and Instruments 6

2.3 Implementation of the CIPP Method in the Hermes Experiments 11

2.4 Constraints and Problems with the Evaluation 14

SECTION 3 Documentation of the Hermes Educational Experiments 16

3.1 The University of Quebec: Réseau Omnibus 17

3.1.1 Background 17

3.1.2 Planning the UQ Experiment 19

3.1.3 The Experiments 23

3.1.3.1 Electron Microscopy (3m: Montreal; 2m: Québec, Trois-Rivières, Rimouski) 23

3.1.3.2 CDES-Amicis (3m: Trois-Rivières; 2m: Québec) 24

3.1.3.3 Télédocumentation and Télérèference (3m: Trois-Rivières; 2m: Rimouski; 1m: Chandler; telephone: Hauterive) 25

3.1.3.4 Graduate Course in Public Administration (3m: Quebec; 2m: Hull) 25

3.1.3.5 Western Quebec (3m: Rouyn; 2m: Hull (link with Ottawa 9m), Val d'Or, Chibougamau; 1m: La Sarre) 26

3.1.3.6 Intercom. (3m: St-Raymond; 2m: Buckingham (link with Ottawa 9m)) 26

3.1.3.7 Oceanography (2m: Rimouski; 1m: Metis) 27

3.1.4 Evaluating the University of Quebec Experiments 27

3.1.4.1 The Hermes Project Evaluation Team 28

3.1.4.2 The University of Quebec Project Team 29

3.1.4.3 The Individual UQ Experimenters 30

3.1.4.4 Operating the Evaluation System 32

3.1.5 Evaluation Results 33
3.1.5.1 CDES 33
3.1.5.2 Télédocumentation and Télérefèrence 34
3.1.5.3 Graduate Course in Public Administration 34
3.1.5.4 Western Quebec 35
3.1.5.5 Intercom 36
3.1.5.6 The UQ Project Seen as a Whole 36
3.1.5.6.1 Observation of the Sessions 37
3.1.5.6.2 Questionnaire Data 38
3.1.5.6.3 Organizational Issues 40
3.1.5.7 The UQ Experiments in the Context of the Hermes Project 42
3.1.5.7.1 Distance Education 42
3.1.5.7.2 Future Satellite Use 44
3.1.6 Conclusion 44

3.2 Memorial University of Newfoundland: Telemedicine Project . . 46

3.2.1 Background 46
3.2.2 Planning the Telemedicine Experiment 48
3.2.3 The Experiment 50
3.2.3.1 Continuing Medical Education 50
3.2.3.2 Continuing Nursing Education 50
3.2.3.3 Consultation Services and the Transmission of Medical Data 51
3.2.3.4 Community Health Education 51
3.2.3.5 Standards in Health Care 51
3.2.3.6 Nutrition Programs for Prenatal Classes and for Diabetics 52
3.2.3.7 Child Abuse 52
3.2.3.8 Slow Scan 52
3.2.3.9 Consultations 52
3.2.4 Simulation 52
3.2.5 The Broadcast Period 53
3.2.6 Evaluating the Telemedicine Experiment 53
3.2.6.1 Planning 53
3.2.6.2 Relation to the Overall Hermes Evaluation 56

3.2.7 Performing the Evaluation 57
3.2.8 Results 58
3.2.8.1 Attendance 58
3.2.8.2 Technical Quality 59
3.2.8.3 Instruction 60
3.2.8.4 Interaction 60
3.2.8.5 The Comparison with Face-to-Face Classes 62
3.2.8.6 User Receptivity 63
3.2.8.7 Instructors' Perceptions 65
3.2.8.8 Cost-Benefit Analysis 65
3.2.9 Conclusions and Recommendations 66
3.2.9.1 From the Evaluators' Perspective 66
3.2.9.2 From the Experimenters' Perspective 67

3.3 The Carleton University-Stanford University Curriculum Exchange 68

3.3.1 Background 68
3.3.2 Description of the Project 71
3.3.2.1 The Satellite Delivery System 73
3.3.2.2 The Videotape Curriculum Exchange 73
3.3.2.3 Project Costs 74
3.3.3 Evaluation of the Carleton-Stanford Curriculum Exchange 76
3.3.4 Evaluation Results 79
3.3.4.1 Carleton's Evaluation 80
3.3.4.2 Stanford's Evaluation 85

3.4 Public Service Commission of Canada: Teletraining for Personnel Development 89

3.4.1 Background 89
3.4.2 Description of the Project 90
3.4.2.1 Objectives 91
3.4.2.2 The Learning Model 92
3.4.2.3 The Course 96
3.4.2.4 The Learning Centres 98
3.4.2.5 The Satellite System 100
3.4.2.6 Project Costs. 100

3.4.3 Evaluation of the PSC Project 101

3.4.3.1 The Evaluation of a Mediated Training Experiment 101

3.4.3.2 The Effects of Learning-Style Preference on Learning, Satisfaction, Participants' Interaction and Attitudes to the Medium 102

3.4.3.3 The Effects of Medium on Behavior, Attitudes, and Satisfaction of Learners 102

3.4.3.4 Cost-Effectiveness Analysis of the Satellite Experiment 105

3.4.4 Recommendations 107

SECTION 4 Observations on the Results of the Educational Experiments 108

4.1 Institutionalization of the Satellite Technology 108

4.1.1 The Technology Answers Real Needs Linked to the Primary Objectives of the Institution 108

4.1.2 The Technology Blends in with Technology Already Being Used 109

4.1.3 The Team Responsible for Implementing the Technology is Integrated into the Institution and not a Peripheral Tack-On 109

4.1.4 Serious Attention is Given to Training Personnel to Use the Technology 110

4.1.5 The Institution Puts Up Some of its Own Resources in Order to Use the Technology 110

4.1.6 The Technology Has High Visibility Both Within and Without the Institution 110

4.1.7 The Use of the Technology is Evaluated 111

4.1.8 Different Departments and Institutions Collaborate on the Project 111

4.1.9 The Technology Favours Reforms and Developments Already Underway in the Institution 111

4.1.10 The Technology has High Transferability 112

4.1.11 Existing Equipment and Courseware can be Used with the Technology 112

4.2 Educational Importance of the Hermes Project 113
4.2.1 Interaction 113
4.2.2 Needs and Expectations Served 114
4.2.3 Increasing Access to Educational Opportunities 115
4.2.4 Innovativeness of Teaching/Learning Methodology 115
4.2.5 Quality of the Educational Experience Provided 116
4.2.6 Learner Outcomes. 116
4.2.7 Impacts of the Educational Projects 117

4.3 Administrative Considerations 117
4.3.1 Needs Analysis 117
4.3.2 Project Personnel 118
4.3.3 Project Management Plan 118
4.3.4 Technical System Design 119
4.3.5 Scheduling, Program Development, and System Preparation 119
4.3.6 Budgeting for the Project 121
4.3.6.1 Satellite System Costs 121
4.3.6.2 Instructional Development Costs 121
4.3.6.3 Instructional Delivery Costs 122
4.3.6.4 Administrative Costs 122

SECTION 5 A Model for the Future Use of Satellites in Canadian Education . . . 123

5.1 Current Trends 124
5.1.1 Technological Trends 124
5.1.2 Political and Economic Trends 125
5.1.3 Regulatory Trends 125
5.2 Elements of a Model. 126
5.2.1 Payment of Costs 126
5.3 Types of Satellite Use in Education 129
5.4 Political and Jurisdictional Issues 130
5.4.1 Legislated Access 131
5.4.2 Ground Operations 131
5.4.3 Scheduling and Management 131

SECTION 6 Conclusion. 132

1 Introduction

Educational applications of advanced technologies typically follow their experimental development and initial commercial applications. When Hermes, the Communications Technology Satellite, was launched on January 17th, 1976, communications satellites were already ten years old. Hermes, however, introduced a number of firsts. Made in Canada and launched by the United States, the Hermes satellite was a joint venture between the two countries. Intended as an experimental rather than an operational satellite its novel technical features were high power (200 watts) and an operating frequency range of 12 to 14 gigahertz. High power in the satellite meant that smaller and less expensive ground terminals could be used. The 12 to 14 gigahertz frequency range allowed the satellite to operate without interference with existing terrestrial facilities.

The principal technological objectives of the program were to:

(1) Develop and flight test a power amplifier tube having greater than 50% efficiency with a saturated power output of 200w at 12 GHz.
(2) Develop and flight test a light weight extendible solar array with an initial power output greater than 1kw.
(3) Develop and flight test a 3-axis stabilization system to maintain accurate antenna boresight positioning on a spacescraft with flexible appendages.
(4) Conduct satellite communications systems experiments using the 12 and 14 GHz bands and low cost transportable ground terminals. (Davies, 1977, p 13)

The primary objectives of the Hermes program were technological. Since these required little actual use of the satellite's capabilities, the Department of Communications (DOC) invited agencies and organizations to submit proposals for communications experiments. Approved experimenters were then allocated portions of satellite 'time' for conducting their projects. Actual utilization was shared equally with NASA on an 'every other day' basis. Hermes marked the first opportunity for Canadian educators to explore the educational applications of communications satellites. Additional public services given access to Hermes included projects dealing with health, community development, and administration. The DOC solicited proposals from across Canada in all of these areas. Some 49 proposals were screened and 25 projects were eventually implemented (Davies, 1977).

Evaluation of the public service sector projects was a major priority of DOC. Each approved project was required to have an evaluation plan. In addition an external team was contracted to prepare a general evaluation design and to evaluate the overall significance of the educational experiments with respect to future educational uses of satellite telecommunications technology. This report represents the completion of the latter part of the evaluation.

Unquestionably, the Hermes educational projects have stimulated considerable interest in educational applications utilizing telecommunications satellites. They have also raised numerous questions regarding how to most effectively and efficiently utilize this new technology. The evaluations conducted provide initial information, but no definitive answers with respect to these questions.

2 Evaluation Summary of the Hermes Educational Experiments

Evaluation of the Hermes educational experiments was a multi-level undertaking. At a basic level each experimenter was responsible for evaluating his own project. Some assigned a member of the project team while others contracted the evaluation to an external consultant. Both the University of Quebec and the Public Service Commission projects had an institutional level evaluation plan and evaluator(s). At the most general level the Hermes educational evaluation team was contracted directly with DOC and had a responsibility for the overall synthesis of the various evaluation efforts.

The general evaluation framework recommended was based on the Context-Input-Process-Product (CIPP) evaluation model (Stufflebeam, D.L., Foley, W.S., Gephart, W.J., Guba, E.G., Hammond, R.I., Merriman, H.O., and Provus, M.M., 1971). In addition a series of evaluation questionnaires, checklists, and interview guides was developed to cover the following aspects of the experiments:

- technical and interactive aspects (questionnaires and checklists for participants and site coordinators)
- participant satisfaction (questionnaire)
- project staff data (questionnaire)
- interview guides for experimenters, instructors, facilitators and participants.

Experimenters could either use some or all of these questionnaires as provided or modify them to increase their applicability to a particular experiment. In a majority of cases experimenters adapted parts of the CIPP procedures and added their own evaluation questionnaires and techniques.

The results of these various evaluation enterprises have produced a wealth of information about the Hermes educational experiments. This report is a summary of the results of each project's evaluation supplemented by on-site observation and interviews with selected participants in the various projects. The present authors accept full responsibility for any conclusions and recommendations which were not presented in the original reports.

2.1 The Evaluation Context

The multi-level nature of the Hermes evaluation enterprise created a number of problems. The major one was that each level of evaluation had its own rationale and different primary objectives. A second problem was the difficulty of separating those aspects of the evaluation related primarily to the technical performance of the satellite technology from others related primarily to effective utilization of the satellite technology for educational applications. Also, each group involved provided its own interpretation of the raw data before passing it on to the next. Therefore, anyone seriously interested in the details of a particular project is advised to consult all of the published reports related to that project.

A number of additional problems in the evaluation can be attributed to the individual experiments. The actual proposals submitted for the various experiments tended to evolve and change from the initial submission through the preparation stage and on into implementation. This evolutionary process was prompted by many factors. These included constraints imposed by funding, lack of specificity and detail in the original proposals, an incomplete understanding of the capabilities of the communication system, and changing policies and priorities within sponsoring agencies and experimenting institutions. This context imposed significant constraints on the nature and objectives of the overall evaluation plan and of individual evaluation schemes.

Inherent in the demonstration nature of most applications is the lack of control associated with the 'real life' situations in which the project events occurred. Consequently, the use of experimental and quasi-experimental research designs (Campbell and Stanley, 1963) was inappropriate in these contexts. As a result the general evaluation design used was based on the CIPP model (Stufflebeam et al., 1971). Evaluation under the CIPP model is defined as "the process of delineating, obtaining, and providing useful information for judging decision alternatives" (Stufflebeam et al., 1971, page xxv). The model combined a focus on objectives, implementation and operational conditions and the more usual formative and summative types of evaluation.

Four major objectives identified by DOC for the overall evaluation project were:

- to create awareness of the potential utility of telecommunications, its problems and advantages, among service agencies and institutions,
- to identify applications of Hermes technology in a variety of projects and user environments,
- to develop strategies leading to the planning of operational communication systems in the public services sectors,
- to analyze and develop policies which will facilitate the application of telecommunications to public services (Casey-Stahmer, 1977).

These create the major context for the results, observations and recommendations contained in this report.

2.2 The Evaluation Plan and Instruments

Evaluation can draw on many types of methodology. Hooper (1977) distinguishes between survey and experimental methods in evaluation and then notes the more recent trend of illuminative evaluation: "The important point about illuminative evaluation is that it examines the context of what is being evaluated. The experimental approach does not get into . . . 'the politics of policy-making'. I believe that educational innovations are political processes, severely political, having to do with particular personalities at particular times, doing things and exerting pressure in certain ways. Now surveys and experiments don't tend to pick up this particular aspect" (Hooper, 1977, p. 337).

The importance of context in educational satellite projects is such that all evaluations must be partly illuminative, even if they rely heavily on survey methods. The study of context involves looking at the costs of the project and the manner in which it was managed. Although such issues are fraught with controversy, knowledge of them is essential to a fair assessment of an experiment.

The CIPP evaluation framework (Stufflebeam et al., 1971) gives primacy to context. The acronym CIPP stands for the four stages of evaluation which can be associated with the progression of a particular project. The first stage is Context evaluation in which descriptive data is collected about the plan for the project. This data includes project objectives, intended outcomes, and criterion measures. Input evaluation is designed to assess the appropriateness and validity of the project strategy selected. Process evaluation examines the implementation of the project procedures and strategies. It is the stage which emphasizes the formative evaluation aspects of each project. Product evaluation attempts to assess the success of the project. It is synonymous with summative evaluation. An additional feature of the CIPP model is that it is sufficiently flexible to suit a variety of projects and a range of evaluation budgets.

Tables 1 - 4 give examples of the application of the CIPP model to the educational experiments conducted in Canada on the Hermes satellite.

TABLE 1

DATA REQUIRED FOR CONTEXT EVALUATION

Questions to be Answered	Data Required
1. What are the objectives for the experiment and why were they selected?	- needs (educational, administrative) to be served by the experiment - data re congruence of experimental needs with sponsoring institution's goals and/or target group(s) - target group(s) for the experiment - statements of experimental objectives
2. What variables must be included in a complete description of the experiment?	- demographic data on the populations involved in the experiment and the experimental context, e.g. students, staff, families, community - data regarding instructional and/or administrative variables, e.g. content, methodology, organization, facilities, cost - measures of cognitive, affective, and psychomotor aptitudes of target populations - data re telecommunications hardware configurations and supporting services and/or materials

TABLE 2

DATA REQUIRED FOR INPUT EVALUATION

Questions to be Answered	Data Required
1. What constraints were imposed on the experiment by limitations in resources?	- data re staff availability and training - data re target groups and estimated participation rates - data re telecommunications facilities and supporting services and/or materials - data re financial resources and their sources - data re satellite time available, the frequency of use, and types and number of terminals
2. What strategy was chosen to achieve the experimental objectives and why was it chosen?	- data re effects of resource limitations - data re established and/or alternative strategies for meeting objectives - data re potential costs and benefits of chosen vs alternative strategies - data re piloting chosen and alternative strategies
3. What procedures were developed to implement the experimental strategy and why were they chosen?	- data re organizational and administrative structure of sponsoring institution - data re logistical supply and support arrangements - data re instructional and/or other events/processes planned for the telecommunications system - organizational chart for the experiment - statements of roles and responsibilities for staff of the experiment - PERT or CPM breakdown of the experiment
4. What were the attitudes of the population involved towards the experimental strategy and how were they informed about it?	- data re motivating and training project staff - data re staff's knowledge of the experiment's objectives and implementation procedures - data re public relations program within target group - data re target group's knowledge about and attitudes towards the experiment's objectives and the experimental strategy
5. How is the experimental strategy to be administered, evaluated, and revised?	- data re on-site co-ordination and monitoring procedures - data re evaluation procedures and instruments - data re data storage, data analysis and information reporting procedures - data re decision-making process for revisions

TABLE 3

DATA REQUIRED FOR PROCESS EVALUATION

Questions to be Answered	Data Required
1. What problems are occurring in the implementation of the experiment?	- data re actual (as opposed to planned) implementation of the experiment - data re interpersonal relationships and attitudes among staff and students - data re effectiveness of communication channels both among and between staff and students - data re the effectiveness of logistical and support arrangements - data re the performance and maintenance of telecommunications devices and other hardware - data re the adequacy of resources (staff, finances, physical facilities, hardware and software) provided for operating the experiment - data re timing and scheduling problems - data re instructional and/or other events/processes which are actually occurring
2. What changes in the implementation and/or experimental procedures need to be made?	- information produced as a result of the analysis of data re problems - records of modifications made to implementation and/or experimental procedures and the reasons for these
3. Are there any unanticipated events/results which are occurring?	- data re the nature of problems/results and their hypothesized causes and/or solutions

TABLE 4

DATA REQUIRED FOR PRODUCT EVALUATION

Questions to be Answered	Data Required
1. To what extent are/have the objectives of the experiment being/been attained?	- criterion referenced performance data re students, staff and hardware - data re participant's changes in attitude and/or acceptance of telecommunications devices and telecommunication based experiences - data re the effects of the experiment on the immediate and long range goals/ plans of the host and/or sponsoring organization(s)

Evaluation data were collected by a number of methods. These included:

1. evaluation questionnaires and checklists
2. technical logs
3. structured interviews
4. examination and analysis of records, diaries, and experimental logs
5. direct observation
6. anecdotal written and verbal information.

More detailed information can be obtained in the Document No. 1: Evaluation Model and Instruments (Daniel, Richmond and Côté, 1976).

2.3 Implementation of the CIPP Method in the Hermes Experiments

The CIPP framework was recommended to individual experimenters by those responsible for the DOC Hermes educational evaluation team. Within this framework, the evaluations of the different experiments revealed an interesting diversity of objectives and methodologies.

Pomfret (1978), in a report on the Memorial University experiment in continuing medical education, declared that "what is being evaluated is the implementation of a social innovation." He conducted an extensive series of interviews before the project and, in the questionnaire instruments administered during the project, concentrated on two issues:

- How often and why people attended the sessions.
- Whether they became more or less supportive.

The curriculum sharing experiment between Stanford University and Carleton University was evaluated by both universities. Carleton concentrated on student attitudes to the technology, comparing them with attitudes displayed to other types of learning environment created previously in the University's Wired City Laboratory (George, 1978).

The report from Stanford (Strover, 1978) concentrated on "planning, management and research features" and called itself a "blend of history, anthropology and fiction". Whereas the Carleton report was based essentially on log-books and questionnaire data, the Stanford account relies on observation, analysis of records, and interviews.

A totally different type of evaluation was conducted for the continuing education experiment carried out between Ottawa and St. John's by the Public Service Commission. This was the only experiment with a proper experimental design and learning outcomes were studied in relation to a series of variables including satellite or non-satellite delivery, degree of extroversion, learning style, degree of interaction and attitude to equipment.

Project Omnibus at the University of Quebec had two evaulation levels. At a general level evaluation was concentrated on an analysis of two-way communication patterns. A variety of additional questions were addressed in the evaluations associated with each sub-project.

Clearly, these five different approaches to evaluation fitted into the CIPP framework in different ways and gave emphasis to different types of data. Although the particular slant of each evaluation probably reflected the biases or experience of the evaluator more than the specific nature of the project itself, there is no doubt that the diversity was useful. A final overall evaluation drawing on the separate evaluations of each of the projects will likely be more insightful and illuminative than a report based on a more centralized approach to the definition of methodology.

The implementation of the Hermes evaluation plan followed an evolutionary process which paralleled that of the development of the individual projects. During Phase I of the evaluation project, April 1975 - March 1976, the initial roles of the evaluators were conceptualized as those of documentation of the individual projects and the preparation of a model representing an overall synthesis of the Canadian educational experiments on Hermes. Associated with these roles was the expectation that the evaluators would function with respect to each project as impartial, third-party, observers. However, following a series of meetings with the individual experimenters and an evaluation workshop held at Ottawa in March of 1976, it became apparent that the evaluation team also had a role to fill in providing consultative services directed towards helping individual project teams prepare their projects for implementation on the satellite system. Three problem areas emerged. These were:

1. project design and management,
2. course and courseware preparation and production,
3. evaluation procedures and instruments.

Phase II of the Hermes evaluation project, April 1976 - March 1977, reflected these new priorities. An initial proposal emphasized the identification of hypotheses related to the institutionalization and assimilation of the satellite communications technology. A subsequent addendum to the proposal led to the development of an evaluation design, the CIPP model, and the preparation of a number of data collecting questionnaires, checklists, and interview guides. These were then presented to the individual project teams as the basis for a comprehensive evaluation scheme. While meetings were held with each project to explain the model proposed and discuss their particular evaluation needs, there was wide variation among the projects in the extent to which the overall plan was actually implemented and utilized.

The final phase of the evaluation project, April 1977 - March 1978, was concerned with observations of actual projects during the implementation/operational stage. In addition a needs survey was conducted among educational institutions in Canada to determine future demand for satellite applications and two hypothetical satellite based educational networks were proposed (Daniel, 1977). The individual projects have now prepared their evaluation reports and these, together with the observations and results collected by the Hermes educational evaluation team, form the basis of this report.

2.4 Constraints and Problems with the Evaluation

Probably the major difficulty encountered in implementing the Hermes evaluation plan resulted from the thinness of the evaluation effort in terms of personnel and financial resources. A second problem was the often competing evaluation agendas enunciated by the Department of Communications and individual experimenters. These led indirectly to a number of difficulties. A fundamental one was the perceived independence between the Hermes educational evaluation team's procedures and instruments and the evaluation efforts mounted by individual projects. The Hermes educational evaluation team could only exercise the powers of friendly persuasion, consultation, and sympathic accommodation in attempting to implement some common evaluation elements among projects. As a result of this, and fundamental differences in objectives among the projects, there is no standardized evaluation methodology among the Hermes projects.

Jurisdictional problems were compounded by difficulties related to the nature of the individual projects. In some instances the satellite mediated experiences could have been amenable to experimental techniques. However, constraints related to personnel and financial resources typically prevented such designs from being implemented. An added difficulty was the very short duration, in relative terms, of most of the educational experiences presented via Hermes. As a result, most of the project evaluation efforts focussed on providing formative data to improve the project during its operational phase and on providing guidelines and information for succeeding experimenters to assist them in effective utilization of the satellite system. This feed-forward of information tended to contribute to the evolutionary nature of many projects. However, it also confounded any attempts to make meaningful comparisons among projects and subprojects.

Some projects (e.g. Memorial and University of Quebec) had independent evaluators associated with their project. Others used evaluators who were intimately associated with the project or attempted more ad hoc evaluations. Again, the particular approach taken was dictated more by constraints in project resources and time then by an intent to ignore or subvert the evaluation process.

In summary the data presented in this report is based on what can be described as a series of case studies. And, since it was agreed that individual experimenters would be first to analyze the data gathered, the information presented in this report is a compilation of that presented by the individual project evaluators supplemented and augmented in some instances by observational and other types of data collected by the Hermes

educational evaluation team. A further caveat is related to the participant/observer/consultant roles which the evaluators performed with respect to many of the projects. As a consequence of these, any conclusions and recommendations made in this report should be regarded as informed judgments rather than unequivocal assertions.

3 Documentation of the Hermes Educational Experiments

Four major projects are included in this report. These are:

- The University of Quebec's Omnibus Project;
- Memorial University of Newfoundland's Telemedicine Project;
- The Carleton University - Stanford University Curriculum Exchange; and,
- The Public Service Commission's Teletraining for Personnel Development Project.

Within each major project there were a number of subprojects. Where documentation exists, these will also be discussed briefly.

This section of the report provides an overview of each of the experiments. More detailed descriptions of the projects can be found in the experimenters' planning documents and reports.

Each project will be outlined as follows:

- a brief description of the project;
- a summary of the project's evaluation objectives, the evaluation plan, and results and conclusions of the evaluation;
- additional comments and observations by the Hermes educational evaluation team; and,
- an assessment of the 'services' provided in terms of need, appropriateness, innovativeness, impact, etc.

3.1 The University of Quebec: Réseau Omnibus

3.1.1 Background

The University of Quebec (UQ) was created in 1968-69, the last major element in the reform and expansion of the educational system which marked the decade of the sixties in the province. The UQ is Canada's only multi-campus university and, because of its recent foundation, a commitment to exploit communications technology to the full was built into the plan for the University.

The UQ network consists of ten institutions. Five are general campuses located at Montréal, Trois Rivières, Chicoutimi, Rimouski, and Hull/Rouyn respectively and the other five are specialized institutes. One of these institutes is the Télé-université, an open university type operation and the fastest growing unit of the network.

The UQ is governed by a Board of Governors which is responsible for overall planning and budget allocation to the institutions. A Studies Council is responsible for academic planning at the network level. The UQ President and Headquarters are located in Quebec City. Although the units in the network have considerable autonomy only the President and his staff are mandated to negotiate with government. This mandate and the responsibility for budget allocation between the units give the Board of Governors and the Headquarters considerable power. However, the network Vice-presidents, such as the Vice-President, Communications, are staff to the President and have no authority within the units of the network.

In 1976-77 some 30,000 students were enrolled in the various units of the network. From its inception the UQ has had a majority of part-time, adult students and the proportion of these students continues to increase, especially with the rapid expansion of the Télé-université which serves only this clientèle.

The original commitment of the UQ to the use of communications technology has had a considerable impact. As well as running an integrated data-processing system for the network and ensuring coordination between libraries, the UQ headquarters have been instrumental in setting up a teleconferencing network which has attracted international attention. However, the teleconference facility, although in routine use, is employed primarily as an administrative tool despite sporadic attempts to teach remote classes by this means.

Apart from ready access to computing power it is fair to say that communications technology has had small effect on the teaching/learning process in the University. Audio-visual technology has had little impact and most classes are conducted in the time-honoured lecture manner. From the student's point of view there is little sense of being part of a network.

This has not been for lack of trying. The communications staff at network headquarters are a competent, dynamic and idealistic group. The group publishes a stream of research and public relations material and communications are a constant theme in the University magazine and its annual reports. However, having no power to implement communications technologies and concepts in the member institutions of the UQ, the role of the headquarters staff is one of informing, encouraging and facilitating in the hope that useful innovations will take hold.

The objectives of the communications strategies at the UQ are defined as follows (Université du Québec, 1978):

- to pool resources so as to increase the institution's collective potential;
- to create a collective communications structure capable of reducing the constraints of time and space;
- to encourage the individualization of learning;
- to encourage more exchanges between the units and to develop a sense of belonging;
- to contribute to the development of regional collectivities and to the improvement of the quality of life in the various regions of Quebec;
- to stimulate community participation in the orientation and development of the University.

In pursuit of these objectives the University is continually in search of new communications systems. The teleconferencing network has been mentioned and at the time the Hermes project was initiated the University was examining the feasibility of both a broadband network to create an interactive video system between the units and a computer dedicated to the PLATO computer assisted learning system.

The UQ believed that experimentation on the Hermes satellite would help to define future directions in its communication strategies and be an important event in its own right.

3.1.2 Planning the UQ Experiment

Unlike other experimenters, who submitted to the Department of Communications proposals for specific experimental projects, the UQ simply submitted a request for a block of satellite time and appropriate terminals. The request explained that the intention was to create a

general omnibus network which various groups in the university could use. The objectives of the experiment were expressed as follows (Tremblay, 1978):

- to promote innovation in teaching, research and management in order to respond to new needs (decentralization of academic resources, individualization of higher education) and to new constraints (restrictions on financial, physical and human resources, development of knowledge, creation of new programs, etc.).
- to determine the type of network best adapted to the needs of a multi-campus university and, in particular, to the special mission of the UQ.
- to measure the impact of communication satellite technology on the learning process at the university level.
- to stimulate the development of technical resources and the training of human resources in the UQ communications sector.

In addition to these objectives four research hypotheses guided the design of the experiment (Dumas, 1978):

- The Hermes satellite, by promoting innovation in several of the communications sectors of the UQ, should reveal the needs of the university community.
- The Omnibus network should have an impact on the institutional behaviour of the UQ.
- The Omnibus network should help the UQ operate as a system.
- A communications satellite offers advantages, compared to terrestrial communications systems, for setting up the Omnibus network.

The aim, therefore, was to use the Hermes satellite system to simulate a versatile communications network which would be integrated, multidirectional, symmetrical and transparent. Although in an operational situation such a network would be used spontaneously as needs arose, rather like the public telephone network, the UQ encouraged its units to plan specific projects so that times could be allocated, terminals installed and equipment prepared.

The manner in which projects were solicited from the UQ units and a choice made among the projects submitted is reported by Dumas (1978).

Although the academic side of the UQ and its units approved the UQ's Hermes project in principle, nearly all the work involved in initiating, planning, operating and evaluating the endeavour was done by the communications sector. Once the project had been approved by DOC, representatives from this sector toured the units in order to explain what the satellite could do and to solicit experiments.

Forty-one proposals were received. Between them they involved all ten UQ units. Naturally, many of these proposals were highly tentative.

A committee then reviewed the proposals using the following criteria:

- technological relevance, i.e. does the particular communications problem require this technology?
- communicational value, i.e. does the communication need to be instantaneous, interactive and easy of access?
- experimental significance, i.e. does the experiment innovate in methodology or research topic?
- reliability, i.e. what are the chances that the experiment will be completed successfully?

- impact, i.e. how will the experiment affect the universities and society in the long term?

The selection committee suggested that a number of projects were inappropriate and should be abandoned. Of these seven were eliminated because they were claimed to require bidirectional video. The Hermes configuration did not allow this in the region concerned. Three more projects fell because they were linked to a fixed schedule which could not be changed in the event of difficulties with the satellite. Two of these experiments involved graduate courses and the third an international conference. Incompatibility with the objectives of the Omnibus network was given as the reason for eliminating five more projects. Essentially these were broadcast applications and did not require instantaneous or bidirectional communication.

With fifteen experiments thus eliminated the UQ units were asked which of the remainder they were prepared to support. A further eleven experiments failed to clear this hurdle. Finally, of those left another five were never carried out for various reasons (e.g. faculty strikes, inconvenient satellite time).

The elimination of two-thirds of the experiments originally proposed created few hard feelings. Many projects had been dreamed up quickly in response to requests from local organizers and frequently would-be experimenters had no idea of the resources and commitment that would be required to see their project through.

The communications staff at UQ headquarters drew up a programming schedule for the experiments that remained. Two new experiments in Western Quebec were added when it became clear that the terminals would be available in that region.

3.1.3 The Experiments

A brief description of each experiment follows. The information in parentheses after the title gives the location and size of the terminals used.

3.1.3.1 Electron Microscopy (3m: Montreal; 2m: Québec, Trois-Rivières, Rimouski).

This experiment ran on Tuesday and Thursday evenings between 2030h and 2230h from October 19th to November 19th, 1976. It consisted of an interactive exchange between bacteriologists in Montreal, Québec and Trois-Rivières. Images of bacteria and viruses in the electron microscope at the Institut Armand Frappier, Montreal, were transmitted live to other sites and the three researchers involved discussed what they saw, calling on reprints, videotapes and other documents as necessary.

The purpose of the experiment was to determine whether researchers in the field could send in specimens to a central laboratory and then review these specimens under the microscope without having to go to the laboratory themselves. Using the audio return channel the magnification and field could be altered in real time at the request of the distant participants.

The following quote (CTS Evaluation Bulletin #1, 1976) gives the flavour of this experiment:

"The first two sessions were marred by audio problems and difficulties with some of the ground equipment but from the third session onwards the experiment was very successful.

An observer had the impression of sitting in on a genuine research discussion and the communications medium employed was unobtrusive. Until November 2nd exchanges occurred mainly between Quebec and Montreal. Unfortunately audio problems, due apparently to weather conditions, made communication difficult from Trois-Rivières during the first session at which this site participated. Although these problems did not recur, Montreal and Quebec remained the most active participants for the rest of the experiment. Exchanges between these sites were extremely smooth, just as if both researchers had been seated side by side in front of the electron microscope."

3.1.3.2 CDES-Amicis (3m: Trois-Rivières; 2m: Québec)

The CDES (Centre for the Development of Learning Environments) carries out innovative projects with teachers in a number of schools around the province. The satellite was used to enable CDES staff to interact with teachers near Quebec City involved in a project. The participants met five times in this manner in November 1976. The interaction involved only audio for the first three sessions and a unidirectional video link, which allowed the teachers to see the CDES staff, was available for the last two.

The objective was to study the effect of a consultation where each participant is in his everyday milieu. The traditional form of consultation implies that each participant is either visited or a visitor and it was hypothesized that this influences the consultative interaction.

3.1.3.3 Teledocumentation and Telereference (3m: Trois-Rivières; 2m: Rimouski; 1m: Chandler; telephone: Hauterive).

Teledocumentation, aimed at improving access to documentation for students in off-campus courses in business management at Hauterive and Chandler, was organized by the UQ Rimouski campus. Students used an audio link to discuss their needs with the Rimouski librarian who forwarded documents to them by facsimile transmitter. The experiment ran from late October to early December 1976.

Telereference involved a video link between the Trois-Rivières and Rimouski campuses. Students in Rimouski explained their needs to the reference librarian in Trois-Rivières whom they could see. The video link was then used to show tables of contents and abstracts to help the student choose the most appropriate reference text. These texts were then forwarded by mail or facsimile transmitter. There were ten sessions totalling 24 hours and involving 18 students.

3.1.3.4 Graduate Course in Public Administration (3m: Quebec; 2m: Hull).

The only classical teleteaching experiment conducted at the UQ, this experiment brought three sessions of a graduate course in management information systems to students in Hull. The one way video link was used to transmit an image of the instructor or his visuals and discussion was possible over the audio link. The objective was to study the changes in behaviour which such an arrangement requires and provokes from both the instructor and the students. The experiment took place between December 9th - 16th, 1976.

3.1.3.5 Western Quebec (3m: Rouyn; 2m: Hull (link with Ottawa 9m), Val d'Or, Chibougamau; 1m: La Sarre)

The UQ's centre in Western Quebec (CEUOQ) serves a sparsely populated area of 400,000 sq. km. With a bidirectional video link between Rouyn and Hull, unidirectional video to Val d'Or and Chibougamau and audio links with other centres, the CEUOQ carried out a series of experiments from February 2nd - 25th, 1977. These experiments were: (CTS Evaluation Bulletin #4)

- a course on the Quebec Labour Movement (8 sessions)
- a teleconference between local agents
- a lecture on vocational education
- telework sessions for the registry staff
- a press conference
- a course on audio-visual techniques
- a course evaluation session

The whole project used about 50 hours of satellite time.

3.1.3.6 Intercom. (3m: St-Raymond; 2m: Buckingham (link with Ottawa 9m))

This project linked community TV stations in two small towns with a bidirectional video link. Two sessions of 3½ hours took place on five different days and allowed some 500 citizens to exchange views on local history, earning a living, leisure activities, culture, and spiritual matters. All sessions were cablecast in both towns from March 14th - 23rd, 1977.

3.1.3.7 Oceanography (2m: Rimouski; 1m: Matis)

This was a technical experiment to see whether oceanographic data could conviently be transmitted by satellite. Data from equipment measuring wave heights, conductivity, depth, temperature and turbidity were transmitted between December 18th, 1976 and January 19th, 1977.

These experiments used some 229 hours of the 313 hours which had been set aside for the UQ project as a whole. The difference is explained by experiments which were abandoned, such as the PLATO experiment scheduled for the Christmas period. Many of the experiments conducted actually used more time than originally scheduled.

3.1.4 Evaluating the University of Quebec Experiments

It was an important principle in the Hermes project that evaluation involve the experimenters themselves as well as the evaluation team. In most of the experiments this led to a two-tier arrangement involving teamwork between the institutional experimenter and the team led by the authors. Since the UQ project was composed of a series of experiments emanating from different units of the UQ network a third tier was added to the evaluation system. Evalution of the UQ project was thus carried out at three levels:

- the individual experimenter (e.g. Fernand Gauthier for CDES)
- the UQ as a whole (which commissioned Dr. Gaetan Tremblay of the Montreal campus)
- the Hermes project (which commissioned the authors).

In an article on the philosophy and methodology of evaluating satellite experiments (Daniel, 1978) we have argued that the involvement of experimenters in evaluation is essential. Naturally, the involvement of many actors complicates the organization of the process but richness and diversity of approach is more important than narrow consistency for complex and innovative projects.

Morever, to interpret the results it is necessary to describe the diversity of the approaches to evaluation in the UQ project. Before presenting any results we will analyze the stance taken by the different levels of evaluation. For this purpose we shall address four key questions:

1. What definition of evaluation is the evaluator using?
2. What audience is the evaluator working to?
3. What are the key evaluation (or research) questions?
4. What is the preferred methodology?

3.1.4.1 The Hermes Project Evaluation Team

Since the approach to evaluation taken by the author's team is detailed elsewhere in this report a brief summary will suffice here.

We took a broad definition of evaluation as the determination of the value of the project. Illuminating the implications of the project for decision-makers at various levels was a key concern.

We have tried to address a variety of audiences in addition to our sponsor (DOC). During the experiments a series of bulletins and reports were written for experimenters with a formative aim. Throughout the project we have condensed the emerging conclusions into journal and conference articles addressed at the international educational and telecommunications fraternity. We have not attempted to address the academic communications research community.

Our primary evaluation question, as defined by DOC, was to derive "a model for future communications systems in Canada". We were also enjoined to pay attention to the "geographical widening of access to education and the changes in teaching strategies and methods which (new communications) facilities require".

As befits our definition of evaluation we have used a broadly applicable methodology based on Stufflebeam's (1971) Context-Input-Process-Product illuminative evaluation technique.

3.1.4.2 The University of Quebec Project Team

The UQ commissioned a team from its Montreal campus to evaluate the UQ project as a whole. This team, led by Dr. Gaetan Tremblay, received funding from both the UQ and DOC.

Tremblay (1978) includes both illuminating decision-making and conducting research in his approach to evaluation. His audience is clearly the UQ community first and foremost although he no doubt expects some diffusion of his work in Canada and francophone countries. We are not aware of any attempts to communicate the results of the UQ project to an international audience other than through an informative public relations brochure (University of Quebec, 1978).

The questions to be addressed are identified clearly. There is an evaluation question and a research question:

- 'What can one do with the satellite?' This evaluation question addresses the cost and usefulness of satellite communication for achieving specific objectives.

- 'What does the satellite do to us?' This research question addresses the cultural and social transformations effected by introducing satellite communication into a given system.
(Tremblay, 1978)

Tremblay does not disguise his greater interest in addressing the second of these two questions.

Tremblay employed three types of methodology: questionnaires, observation and bibliographic research.

3.1.4.3 The Individual UQ Experimenters

Substantive (and substantial) reports have been issued on most of the UQ experiments viz: Télédocumentation and télérefèrence (Houyoux and Mercure, 1978); CDES, Western Quebec and the graduate course in public administration (Jomphe, Gauthier, Boivin and Chenard, 1978) and Intercom (Desaulniers, Demers and Tremblay, 1978). The evaluative stance of the individual experimenters may be described briefly from these reports.

The evaluation of the CDES project was equated with answering a research question. Although the report (Jomphe et al, 1978) is written essentially for a UQ and DOC audience we imagine steps will be taken to communicate the results to an international audience of those responsible for the in-service training of teachers. The research question was whether the fact of working with teachers via satellites has beneficial effects beyond the elimination of travel. We shall explore later the 'visitors/visited protocol' which is associated with this question. The CDES team described their methodology as an anthropological research style aimed at clarifying decisions. Instruments included a specially developed inventory of characteristics of educational intervention, structured interviews, a grid for describing speakers and interventions and two questionnaires based on the standard instruments prepared by the Hermes evaluation team.

Evaluating the graduate course in public administration was aimed at helping decision-makers in the University to know whether giving courses at a distance via a video link was worth the effort. Observation and survey questionnaires were the methods used.

In Western Quebec evaluation was concerned with assessing the comments and reactions of the participants and working out the total cost of the project. An audience within the University is aimed at in the report. Questionnaires were used to determine attitudes and CEUOQ accounts were analyzed to discover costs.

The library experiments (télédocumentation and téléreférence) saw evaluation as the testing of a series of explicit hypotheses. Although we assume the results will be published for the benefit of librarians around the world the reports we have seen to date are primarily aimed at a University audience. The research hypotheses can be summarized into the question, 'can an interview with a librarian via satellite lead to the identification of appropriate reference material?' Information was obtained largely through questionnaires.

Evaluation of the Intercom project was aimed at providing a structured description of what occurs when the cable TV systems of two towns are joined for an interactive exchange. We do not know whether the experiment has been written up for audiences outside Quebec. No single research question or hypothesis was identified and information was gathered by questionnaires, observation and interview.

3.1.4.4 Operating the Evaluation System

That the evaluative enterprise just described turned out to be difficult to coordinate is not surprising. Quite apart from the number of people involved and the diversity of their aims, other events did nothing to lessen the entropy of the system. Last minute changes in satellite and experiment schedules, the difficulties of travel in a Quebec winter and a lengthy strike which shut down the UQ's Montreal campus for much of the experimental period all hindered planning and execution of the evaluation. Furthermore the limited funds available meant that both evaluators and experimenters were involved with their projects on a part-time basis only. This affected all phases of evaluation from design through data-gathering to interpretation.

However, the differences between the conceptual frameworks used by the evaluators were an even greater source of difficulty. The best illustration of this problem concerns the notion of need. Comparison of the objectives of the UQ experiment (para 3.1.2) and of the objectives of our Hermes project evaluation team (para 3.1.4.1) shows a fairly good match. Perhaps for this reason it was not until the experiments were well underway that the differences in the approaches to evaluation became noticeable. For the Hermes evaluation team the notion of educational need was an important element in the approach used, which drew on a model designed to evaluate the effectiveness of learning systems set up to satisfy identified needs. Although the team was sufficiently lucid to realize that in the Hermes experiments the availability of the satellite came before the identification of the needs, we supposed that needs were implicit in the experiments carried out. This led to some frustrations which Richmond (1977) has called "An Evaluator's Paradox: Demonstrations in the Absence of Demonstrated Need".

Dr. Tremblay's team, applying a conceptual framework from communications research, was largely unaffected by such frustrations. Their attitude to the role of educational need in the experiments has been well expressed by Dumas (1978).

"Needs analysis based only on explicitly stated desires is now an historical curiosity. . . . Innovation is a better way to reveal needs. To innovate is to sense real needs which the user is unable to express clearly. This is why innovations, like lighthouses, light the path of needs analysis whereas the expressed needs are only a rear-view mirror.

". . . the Omnibus network experiment corresponds to a process of needs analysis" (p. 127).

We can only hope that by watching both the lighthouse and the rear-view mirror this composite evaluation has charted the course thoroughly.

3.1.5 Evaluation Results

We shall first summarize the conclusions of the individual experimenters, then discuss the results obtained by the UQ evaluation team and, finally, assess the lessons of the project within the Hermes series as a whole.

3.1.5.1 CDES

The experimenters concluded (Jomphe et al, 1978) that in-service training of teachers can be carried out using an interactive telecommunication link. It helps if there is at least a one-way video link at alternative sessions. The experiment gave support to the hypothesis that the elimination, by the satellite, of the behaviours which characterize the visitors and the visited in a face-to-face meeting leads to more effective interaction.

3.1.5.2 Télédocumentation and Téléréférence

These experimenters concluded that librarian-client interviews by satellite are both possible and efficient. Video is unnecessary although a teletype link would be useful. The interviews are most conveniently in two parts; a first where the client puts his questions and refines them in discussion with the librarian and a second part, after the librarian has had time to do some research, at which appropriate documents are suggested.

This type of communication does not require a satellite if there is a terrestrial telephone system.

3.1.5.3 Graduate Course in Public Administration

The experimenter's report on this project (Jomphe et al, 1978) concludes that the preparations an instructor has to make to teach at a distance are "absolutely disproportionate" to the advantage there may be in reaching distant classes. This type of teleteaching would not survive a cost-benefit analysis. Furthermore, this type of teleteaching puts both students and instructor under unreasonable constraints. It is suggested that: "teleteaching requires major changes and adaptations, it is not simply a matter of televising a normal lecture".

In its recommendation the report suggests that future experiments should emphasize bidirectional communication and that not more than two sites with a total class of 15 to 20 students should be linked.

3.1.5.4 Western Quebec

Although the report on the Western Quebec project (Jomphe et al, 1978) does not include reports on the separate experiments of which it was composed, the questionnaire data gathered has been broken down in this way. The evaluation of the teleteaching experiment (a course on the Quebec Labour Movement), which involved several sites and a fairly interactive teaching strategy, was more positive than that of the graduate course in public administration (para 3.1.5.3). The data tables allow comparison of the Labour Movement course with the telework and teleconference experiments. Although a greater proportion of participants joined in the discussion in the latter experiments most students in the Labour Movement course rated the communication "very spontaneous".

In their conclusions the experimenters state, that in teleteaching by satellite, courses must be prepared by a team rather than an individual which improves course quality. They doubt whether most teachers can use television effectively and make the point that the gap between technology and the academic mentality seems to be continually widening.

> However, despite these worries, the report ends as follows: "Aside from the technical contraints, which are likely to disappear in the coming years, we think that the satellite offers the most appropriate means for our Western Quebec region of the University".

3.1.5.5 Intercom

Although the report on the Intercom project (Desaulniers et al, 1978) is general and descriptive it does make some interesting points.

The experiment certainly attracted the interest of the citizens of the two communities which were linked. Audience ratings for the local TV channels hit an all-time high. A hundred citizens contributed during the exchanges and the presence of their friends in the studio seemed to help, rather than inhibit, individual speakers.

It is not always easy to strike a balance between the contributions from the two communities. The town which was the technical headquarters for the experiment appeared to have an advantage and the style of the local hosts and anchor men may also have caused the communication to be somewhat unequal between the two groups.

3.1.5.6 The UQ Project Seen As a Whole

The objectives and methods of the University of Quebec evaluation team lead by Dr. Gaetan Tremblay were summarized in para 3.1.4.2. The results of this work are presented in the last volume of the UQ report (Tremblay, 1978).

Dr. Tremblay conducted his work under difficult conditions. His original plan was ambitious in view of the limited resources and time available to his team and when a long strike closed down UQAM for much of the experimental period it made matters even more difficult.

In the report he admits that neither the questionnaire data nor the observation results have been explored as fully as possible. Indeed, in the report one senses a certain disappointment that the experiment itself and the results obtained did not allow the original research question to be addressed very meaningfully. As a result the first chapter of the report, 'Elements of a Theoretical Framework', seems to flow into the last, 'Satellites and the University of Quebec network', almost without reference to the seven chapters in between which describe the project and its results.

3.1.5.6.1 Observation of the Sessions

Although the UQ team placed major emphasis on observation of the sessions, time and resources made it impossible to carry out the original plan of videotaping all sessions for later analysis. The observers' reports noted the following phenomena:

- Authority relationships (e.g. teacher/student) were more in evidence than interaction between equals.
- People often behaved 'as if they were on TV'.
- Sessions went better when the content was planned in advance.
- The asymmetric communications links imposed by some terminal configurations put some groups at a disadvantage.
- People get tired of repeating their names for identification purposes.
- Showing film or videotape clips to all sites helps focus discussions.
- Asking questions to participants helps to keep them attentive.
- Participants should not be packed together too tightly in the 'studio'.

- Equipment and cameramen are not distracting although a monitor showing a group a picture of itself can be.
- Attention drops during lengthy speeches.
- Technical problems can help to increase the level of participation.
- The satellite delay does not appear to cause problems.
- There is a tendency for competitiveness or "we-they" consciousness between different sites.

From these observations the UQ evaluators concluded that the recipe for successful distance communication is to have good quality sound and picture coming alternately from different sites. The participants should know what they are talking about and make short interventions. The use of documents available to all or of video clips shown to all is helpful.

3.1.5.6.2 Questionnaire Data

Questionnaires dealing with the technical and communicational aspects of the experiments were developed by the Hermes evaluation group and refined in discussion with the UQ team which then adapted them to the various experiments.

Tremblay presents the responses to those questions which were asked of all participants and notes that the data are given without distinguishing between the experiments. Since the number of participants in each experiment varied widely the questionnaire data is strongly biased in favour of three experiments which contributed the overwhelming majority of the 815 questionnaires received. These were Western Quebec, Intercom, and the graduate course in public administration.

The following highlights of the responses obtained are, therefore, little influenced by CDES, the library experiments and the electron microscopy project.

- Technical equipment and configurations allowed satisfactory participation.
- Less than half the participants were satisfied with the comfort and arrangement of the rooms used in the experiment.
- The overwhelming majority of users (92%) were satisfied with sound and image quality in terms of the objectives of experiment.
- A large majority found the equipment easy to use (88%) and the prior explanations adequate (80%). However, only half of the site coordinators ever experienced a problem-free session. Nearly half the participants never heard the satellite echo.
- Most participants (81%) felt the technical set up allowed them to achieve the objectives of their experiment but fewer (65%) would like to use it on an operational basis.
- Most (59%) participants felt that only a few people took part in the discussions and only half (52%) felt encouraged to do so. However, most (83%) knew who was speaking at any given moment.
- Most (61%) felt the sessions ran on predetermined tracks and nearly half (48%) felt that questions and comments had little influence on the direction of the discussion.
- Short silences disturb the experimenters (who fear breakdown) much more than the participants.

- The relative importance of different types of contribution to the discussion was:

Presentation of information	39%
Expression of agreement	37%
Requests for information	29%
Requests for further explanation	27%
Presentation of further information	25%

- Organizational interventions were not excessive and there seem to have been few discordant notes (0% disagreement), few (2%) irrelevant observations and little (12%) real discussion.
- Less than half (48%) found the communication spontaneous although two-thirds found it useful (63%), interesting (65%) and clear (65%).
- The length of sessions was about right and less than 20% of participants were distracted by the technology.
- Less than half (48%) found the communication by satellite as easy to grasp as face-to-face communication but 60% felt the satellite brought groups together.

3.1.5.6.3 Organizational Issues

Tremblay devotes one chapter of his report to institutional factors which influence the success of the experiment. A literature survey had suggested that motivation, preparation and resources were key factors in the success of satellite communication experiments and the UQ experiment has confirmed this.

Tremblay notes that the experimenters were volunteers motivated by interest in innovation, prestige and promotion possibilities rather than by material gain. To a large extent the experiments were personal, rather than institutional projects. None of these conditions would be appropriate in an operational system.

The preparation and organization of the project revealed some weaknesses in the UQ structure. Indeed, this ten unit network seems to mirror, on a small scale, many of the administrative, geographical, political and jurisdictional problems of the ten province Canadian confederation. However, an operational project would be organized with more care. The extensive data-processing system linking the UQ campus does not, for example, seem to present any particular administrative problems.

There was wide unanimity that resources were "incredibly small". There were few extra staff and few reductions in workload for regular staff. The rooms used were ill-equipped, small, stuffy and uncomfortable. There were many problems getting equipment and connectors.

We analyze elsewhere the level of public funds committed to the experiments from sources outside the institutions concerned. Obviously, any value judgements about the appropriateness of the levels of internal and external funding must depend on the perceptions that are held of the importance of the experiments in the attainment of the objectives of the institutions and of the Government of Canada.

3.1.5.7 The UQ Experiments in the Context of the Hermes Project

In paragraph 3.1.4 we noted the (perfectly legitimate) differences between the objectives of the University of Quebec evaluators and those of the Hermes evaluation team. We shall examine here the results of the UQ experiment in terms of two major preoccupations of the Hermes team; distance education and future satellite use.

3.1.5.7.1 Distance Education

The "geographical widening of access to education" was an important theme in the mandate given to the Hermes evaluation team by DOC. Although the University of Quebec itself was set up in the late sixties partly to ensure a geographical widening of access to higher education this particular objective was not a major thrust of the UQ satellite experiment. Very few of the participants in the teleteaching experiments were people not already taking UQ courses by other means.

This should not be interpreted as an indication of any lack of interest by the UQ in distance education. Indeed, when the tenth unit of its network, the Télé-université, was created in 1972 the UQ was responsible for the first manifestation, in Canada, of the open university movement. Although the Télé-université made a hesitant start it was undergoing a phase of explosive growth during the period of the Hermes project and by 1977/78 had some 12,000 active students, a significant proportion of the total UQ enrollment.

Although the Télé-université proposed a small satellite experiment, involving tutorial and group support for one of its courses, the project was abandoned because of inconvenient scheduling. Since the Télé-université has students all over the province, from the Magdalen Islands to James Bay, it was clearly difficult to incorporate a satellite network with only a few terminals into the regular teaching activites. These activities are based on multi-media home-study packages supported by a network of local tutors and group meetings, a system similar to that pioneered by the U.K. Open University.

However, the report on the UQ satellite experiments shows that it was not simply for pragmatic reasons of terminal availability that the UQ did not use the satellite to further distance education. It is clear that the whole thrust of the UQ philosophy of satellites is towards interaction between individuals and small groups.

However, as the report itself shows, the multi-directional, interactive possibilities of the satellite were not fully exploited in the experiments. The data shows that most participants saw the experiments more as televised spectacles than as a new genre of face-to-face discussion. Several divergent conclusions can be drawn from these facts.

Although Tremblay believes in the democratization of communication by the use of satellites his approach to distance education does not suggest a corresponding belief in the democratization of knowledge. The model of the teaching/learning process which emerges is essentially authoritarian. Distance education, he says, should consist of giving the professor instruments which will allow him to

simulate most closely a face-to-face lecture. Later he backs away somewhat from this position, admitting that full interactive video communication with a geographically distributed class may not be cost-effective and suggesting that the lessons could be sent out beforehand on print or tape so as to reserve the interactive network for questions and discussions.

3.1.5.7.2 Future Satellite Use

The Hermes evaluation component was funded in connection with the DOC space programs. The implications of the experiments for future satellite planning were an important part of the study.

Although the UQ rightly treated the project as a communications experiment in which the presence of a satellite was incidental, it is important to note that the University has carried out, for the Quebec Department of Communications, a major study on the implications of satellites for Quebec after 1980 (UQ, 1977). After reviewing the likely evolution of communications technology and costs this study did not predict a significant role for satellites for communications within Quebec. For all projected educational uses terrestrial systems would be more cost-effective, although access to satellites for occasional international exchanges would be useful.

3.1.6 Conclusion

The University of Quebec conducted a series of varied experiments with strong emphasis on interaction. Participants felt that the objectives of the experiments were met although only two-thirds of them would like to engage in similar telecommunications-based

activity on a regular operational basis. This may be partly because the communications facilities were not used as interactively as the experimenters had hoped.

Although the University of Quebec is more active in distance education than any other institution in Canada, interactive telecommunications systems are not likely to play a major role in this activity at the University. However, the University is likely to make increasing use of terrestrial communications facilities for voice, video and data traffic between the units of its network.

3.2 Memorial University of Newfoundland: Telemedicine Project

3.2.1 Background

The creation of Memorial University of Newfoundland (MUN) goes back to 1925 and it acquired full University status in 1949 by one of the first acts of the House of Assembly after Newfoundland joined the Canadian confederation. Memorial is the only University in Newfoundland and Labrador and its objectives are: (1) to develop in the Province an institution of higher learning deserving of respect for the quality of its academic standards and of its research; (2) to establish new programs to meet the expanding needs of the Province, and (3) to provide the means whereby the University may reach out to all the people.

The third of these objectives presents a special challenge because of the geographical distribution of the Province's people. Communications with the many outports dotted around the coasts of Newfoundland and Labrador are difficult. In responding to the challenge Memorial became, in 1969, the first Canadian University to initiate a distance education program. An Educational Television Centre (ETV) had been established in 1967 and this Centre worked with the academic departments to prepare videotaped courses as the basis for the off-campus program. These courses are now offered in thirty-six centres.

Interestingly, Memorial was also a Canadian pioneer in teleconference teaching. Although the quality of the telephone system in the 1960s was inadequate and teleconferences were not long a part of the off-campus program, the idea remained alive.

No doubt because of its key role in importa : activities of the University the Educational Television Centre attracted high quality staff and became within ten years the best unit of its kind in Canada. Given this resource on campus, the geography of the Province, and the mandate of the University it only needed an interested academic group to make Memorial a natural participant in the Hermes project.

Such a group was the Faculty of Medicine. The creation of a Medical School and Health Sciences Centre at Memorial was recommended in 1963 and continuing medical education for doctors throughout the province was an important task to be tackled even before the first undergraduates were admitted in 1969. Among the objectives of the Medical School are: (1) to accept responsib.lity for assisting doctors in continuing their medical education whether they choose to specialize in family medicine, research or other work; (2) to contribute to knowledge through research in the University and its hospitals and the community; and, (3) to contribute to the total effort of all members of the health team so that the best possible standards of medical practice are achieved.

The importance attached to continuing medical education in the objectives of the School and the niversity was matched by the quality of the individual responsible for this activity. Dr. Max House, a native Newfoundlander and the Assistant Dean of Clinical Affairs, was the initiator and director of the Telemedicine project. No one involved in Canada's Hermes project won more affection and respect from his co-experimenters.

3.2.2 Planning the Telemedicine Experiment

Planning for the Telemedicine project began in 1972. After DOC had explained the Hermes project at a meeting in St. John's a fifteen member Newfoundland Communications Technology Committee (NCTC) presented a preliminary proposal for experiments emanating from ten different institutions. House and McNamara (1978a) report that a commitment by the ETV to allocate 50% of its resources to the planning and production of programmes was central to this proposal.

The Continuing Medical Education office of MUN proposed a variety of medical education programmes as part of the project which was to run for four weeks in 1976.

In 1973, after NCTC had applied to DOC for a grant of $29,860 to establish a project planning office, $7,000 was received to carry out a study entitled "Study and Evaluation of the Possible Sociological Benefits and Design Criteria of Operational Orbiting Satellites for Communications with Remote Communities in Newfoundland and Labrador". This grant was used to pursue planning and a new proposal was presented in early 1974 to the Hermes Evaluation Committee. This proposal contained two experiments instead of ten. One of these was a 31 hour Telemedicine project made up of Continuing Medical Education (CME), Medical Consultation Service, Transmission of Medical Data and Community Health Education. This represented a change from the original proposal in which CME had played a larger part. The budget required the technical aspects and the evaluation of the project were not addressed in the new proposal.

For the calendar year 1974 the NCTC received a contract of $21,999.95 for "Socio-economic Studies Relating to the Newfoundland Experiments with the Technology Satellite (NETS)". In July 1974 the Hermes Evaluation Committee approved the NETS proposal so that it became an official part of the Hermes program.

NCTC was awarded a further contract of $39,420 for a thirteen month period from January 1st, 1975 for "Newfoundland Experiments with the Technology Satellite". In April 1975 a submission requesting $471,634.56 was made to the Canadian Urban Demonstration Program (CUDP) of the federal Department of Urban Affairs. This submission was returned in July 1975 due to the cancellation of CUDP.

Although a project office had been kept in being by the DOC grants it had directed its efforts to fundraising and minimal planning. The failure to receive a major grant was a severe blow which House and McNamara (1978a) attribute to two problems: "(1) the project in its entirety was too broad to fit into any one agency's guidelines, and there was particular difficulty in funding the technical costs: and (2) since the satellite was experimental, many Departments thought that taking the risk of first exploring its potential was part of DOC's mandate, not theirs".

When the CUDP request fell through a major reorganization took place. The NCTC was disbanded and ETV and the Faculty of Medicine banded together to carry out the Telemedicine project as a University research endeavour. The configuration of the network was reduced to 2m terminals at Stephenville, Happy Valley, Labrador City and St. Anthony, thus abandoning the 1m terminals on the Labrador coast which had been part of the earlier proposal. Now that the project was a reality new worries began to emerge. ETV had entered the project in order to help with production and had not bargained for being responsible for the technical and engineering planning which was eating into the project budget. Moreover a simulation facility was thought necessary to improve course preparation. For this purpose DOC gave $15,000 towards a microwave link between the University and the General Hospital which eventually cost $30,000. Although $13,000 was also received from DOC to prepare the evaluation component, lack of funding and simulation facilities made it difficult to do more than make preliminary contact with the Hermes evaluation team.

In 1976 DOC provided a further $51,063 to the project and more than half of this sum was to be allocated to interface equipment and software development. Early in the year the School of Nursing joined the project to provide 10-12 hours of courses to nurses in the four participating hospitals. ETV took over responsibility for interfacing with the terminals.

As the experimental period approached DOC provided a further $124,208 for the period from July 1st, 1976 to December 31st, 1977.

3.2.3 The Experiment

By July 1976 the plan for the experiment was made up as follows:

3.2.3.1 Continuing Medical Education

This part of the experiment involved four topics

- Communication/Development Disorders in Children. 5 two hour programs
- Cardiology. 9 one hour programs
- Anaesthesia. 6 one hour programs
- Therapeutics. 6 one hour programs

3.2.3.2 Continuing Nursing Education

This series was planned to address the topics using seven different instructors.

3.2.3.3 Consultation Services and the Transmission of Medical Data

No concrete plans had been developed for this facet of the project by July 1976. Its importance diminished from that point on because the 3m (video emitting) terminal was at St. John's and furthermore a Hermes experiment at the University of Western Ontario was devoted exclusively to these services.

3.2.3.4 Community Health Education

Preparations for this component of the experiment had been held in abeyance in order not to raise hopes before funding was assured.

In each of these broadcasts (the Newfoundland experimenters, unlike their Quebec colleagues, had no hang-ups about using this term) the format and style called for a total of about 20 minutes of pre-programmed material per hour of air time, the other 40 minutes being set aside for interaction. The pre-programmed pieces were to be 'visual' TV with 'talking head' presentations kept to a minimum. However, the emphasis remained on exploring the potential of the Hermes system rather than developing new course material.

Although the Extension Service had withdrawn from the Memorial CTS project in 1975 the number of hours of air time remained unchanged at 150. Since the series described above accounted for only 40 hours, further programming was started in the latter half of 1976.

3.2.3.5 Standards in Health Care

A series of 7 one and a half hour programs developed by the Newfoundland Hospital Association for its members.

3.2.3.6 Nutrition Programs for Prenatal Classes and for Diabetics

3.2.3.7 Child Abuse

A series of 4 two-hour programs.

3.2.3.8 Slow Scan

An extra audio channel was requested on the Labrador City 2m terminal in order to permit slow scan transmission of X-rays.

3.2.3.9 Consultations

A hospital in St. John's was equipped with a 2m terminal and provided with consultative services by the Hermes Medical Team.

3.2.4 Simulation

We noted in para 3.2.2 that prior simulation of the experiment on terrestrial facilities was an important part of the project plan. Although the microwave system had been scheduled to be available in January 1976 it was not until January 1977, only a few months before the Hermes broadcasts began, that it became operational. However, House and McNamara (1978) report that the system was still very useful since it permitted course leaders at the MUN campus ETV Centre to try out their programs on a small audience at the General Hospital 5 miles away. As in the satellite experiments there was an audio link back to the campus. In fact, many of the 23 simulations were carried out on alternate days between the broadcasts and the project team believes that prior simulation resulted in better broadcast programs.

3.2.5 The Broadcast Period

The schedule of satellite time available to the project was as follows:

Date (1977)	Period	Day of Week
March 14 - April 1	1430-1630	Monday, Wednesday, Friday
March 28 - June 18	0800-1100	Tuesday, Thursday, Saturday
April 26 - June 18	1400-2100	Tuesday, Thursday

The final breakdown of the broadcast time between the various components of the project was as follows:

Continuing Medical Education	57½	hours
Continuing Nursing Education	13½	
Standards in Health Care	12½	
Community Health Education	22	
Consultations	4½	
Opening and Closing Ceremonies	5	
Special Programs	21	
Total	136	hours

3.2.6 Evaluating the Telemedicine Experiment

3.2.6.1 Planning

Although there had been regular contact between the Telemedicine project and the CTS evaluation team from 1975 onwards, it was not until the Fall of 1976, when Dr. Alan Pomfret of Memorial's Institute for Research in Human Abilities was awarded a contract by DOC, that the project gained its own evaluation component.

Although the original intention had been to focus on both the educational efficacy of the project and factors associated with its implementation, the course structure evolved so as to make any meaningful assessment of learning outcomes impossible.

Pomfret (1978) in his final report draws together many of the conclusions reached by the experimenters and the participants during the project. As well as providing a good description of the context of the experiment his illuminative study is oriented specifically towards the evaluation of "the implementation of a social innovation".

In para 3.1.4.1 we suggested four questions which are useful in distinguishing between different approaches to evaluation. These concern the operational definition of evaluation, the audience for the evaluation, the principal questions addressed and the preferred methodology.

Pomfret began his evaluation with the intention of measuring the degree of attainment of the stated objectives of the continuing medical education component of the project. The "general objective of the CME exploration is to determine whether a 'satisfactory' learning experience can be delivered to health professionals without their having to leave their place of work".

The primary audiences for such an evaluation would presumably have been the Memorial University community and DOC. The three main topics to be investigated were learning outcomes, learning conditions and a cost-benefit analysis of the operation. In such a study the measurement of learning outcomes was clearly an important part of the methodology.

However, realizing that many other features of the project besides the delivery system would have an impact on learning outcomes, an examination of learning conditions was a major component of the evaluation from the beginning. Since the manner in which the project was implemented could account for differences in learning outcomes two aspects of project implementation were identified for special attention. These were: (1) pre-course conditions which influenced whether people decided to participate in the courses, and, (2) course involvement factors or conditions which prevailed during people's actual participation which could explain how participants' perceptions of, and hence their reaction to, the project changes during actual broadcast time.

In fact, in the time between the preparation of the evaluation plan and the study itself the project changed considerably. CME, which had been scheduled to take up 80% of the air time used only 42% because of the new courses which were added. More importantly, the format of the courses changed considerably. The original project called for four courses, each lasting a month or more, aimed at stable groups of physicians. In the event, the project became a succession of mini-courses lasting one or two hours and aimed at a mixed audience of doctors, nurses and assistants.

The new format and the inclusion of many new topics made the measurement of learning outcomes rather pointless and led Pomfret to concentrate his efforts on evaluating "the implementation of a social innovation". In so doing he considerably expanded the audience for his work because of the potentially greater generality of the results. Naturally the change in emphasis also required a change in methodology with more reliance being placed on interviews and less on survey questionnaires.

The cost-benefit analysis also became a less significant factor when it was realized that the project, as carried out, was not comparable to any existing educational service. The four courses for physicians originally planned did bear some relationship to face-to-face in-service sessions run by Memorial but the new mini-courses, with their diversified clientèle, were essentially sui generis in Newfoundland.

Because the new format sharply increased the number of users, the evaluators could plan to use statistical methods which had not previously appeared relevant.

The study of the implementation of this social innovation centred on two questions: (1) How often and why people attended the broadcast sessions; and (2) Whether and why people became more or less supportive of the project.

3.2.6.2 Relation to the Overall Hermes Evaluation

During the evaluation of the Telemedicine project there was relatively little interaction with the Hermes evaluation team. Before Dr. Pomfret's appointment this team had been in regular contact with Dr. House and his colleagues on the Telemedicine project and had supplied them with all documentation relating to the overall plan and its component instruments as it became available. By the time Dr. Pomfret began work the Hermes evaluation team was heavily committed to the UQ and Carleton experiments then in progress and only a few meetings with him were possible. Although some of the items from the Hermes team's questionnaires were incorporated into the Telemedicine interview schedule Dr. Pomfret and his colleagues must take full credit for planning and carrying out the evaluation. The Hermes team was most interested in the approach to evaluation used in the Telemedicine

project and we shall discuss later in the report the light that Dr. Pomfret's study of the implementation of an innovation throws on some hypotheses about the institutionalization of technology which were one of the interests of the team.

3.2.7 Performing the Evaluation

Most of the data for the evaluation was collected by interviewing experimenters, instructors and participants using structured interview checklists. The schedule of interviews was as follows:

1. Two months before the broadcast period a 2-3 day visit was made to each of the four participating hospitals to interview (at least): (1) the doctor who had been the main contact with the project planners; (2) the person in charge of in-service nursing education; and (3) the chief administrator of the hospital.

2. Just prior to the broadcast period an interviewer went to each hospital to survey and interview all health care professionals (doctors, administrators, nurses, nursing assistants). The interview was based on a short structured questionnaire with open-ended questions and every effort was made to administer it to all staff.

3. About half way through the broadcast period the operation described in (2) was repeated with a slightly different interview questionnaire.

4. Immediately after the broadcast period the operation described in (2) was repeated with another interview questionnaire.

5. Course instructors and producers were interviewed.

Further information was gathered as follows:

6. Attendance figures were provided for each session by the contact person at each hospital.

7. A participant satisfaction questionnaire was administered at three points during the broadcast period.

8. Files were reviewed to obtain cost-benefit data.

3.2.8 Results

In this section we shall summarize the results of the evaluation. A fuller analysis and presentation is given by Pomfret (1978).

3.2.8.1 Attendance

Of 452 potential attenders at the four hospitals, some 269 attended one or more broadcasts. Attendance was highest for administrators (85%) and somewhat lower for doctors (64%) and nurses (63%). Only 34% of all nursing assistants attended a broadcast. In terms of the average number of broadcasts attended by those participating, doctors scored highest with 9.9 followed by administrators (4.6), nurses (4.3) and nursing assistants (2.8).

The study revealed that on average, over three quarters of the participants were attending fewer broadcasts than they expected to attend. These feelings were especially strong among nurses (85%) and nursing assistants (over 90%) whereas the attendance of doctors and administrators corresponded more nearly to their expectations and preferences.

As might be expected, each professional group tended to predominate in the audience for broadcasts designed for that group (e.g. doctors were a majority at doctors' sessions) although

nurses often watched broadcasts aimed primarily at other groups. Analysis of the data revealed that the initial receptivity of individuals to the project influenced whether they would attend at all or how often. However, the number of broadcasts attended by participants was unrelated to their perceptions of broadcast, instructional and interactive quality, possibly because these perceptions were generally rather favourable. Participation in project-related activities prior to the broadcasts made attendance more likely as did receiving clear information about the project before it started.

Once the project was under way the difficulty of attending sessions (e.g. because of broadcast times) strongly affected attendance whereas workload did not appear as a factor. However, the degree to which participants felt like participants, rather than observers, correlated with attendance. The personal backgrounds of participants and their previous experience with in-service training and audio-visual equipment had no impact on attendance.

3.2.8.2 Technical Quality

The various technical aspects of the project were rated good or very good by most participants and the equipment performance was seen as fairly consistent. The availability of TV monitors and the volume of sound rated particularly highly. Contact with the satellite was judged to deteriorate slightly during the project and this was accompanied by an increase in echo and a decline in picture-quality. However, despite these changes the overall technical picture is one of high quality.

3.2.8.3 Instruction

The participants' responses indicate that the instructional component of the project was well received. Although clarity of presentation received the highest rating, standards were high throughout. However, a majority felt that the sessions were too long and this may explain the slight deterioration in the perception of the instructional aspects of the broadcasts as the project progressed. With a heterogeneous audience the level of courses is always hard to set. However, although only one quarter of the participants found the courses set at the right level, the remainder divided equally between those who found it too advanced and those who found it too basic. A rather interesting discovery was that, although half the participants felt the instructor did not often treat them like colleagues, nearly half said they were never treated like students.

3.2.8.4 Interaction

If one had to select a word to express the theme of Canada's Hermes experiments the choice would undoubtedly fall on interaction. All experimenters considered interaction to be a major feature of their project. In the Telemedicine project the participants apparently shared this view. Few considered that the two-way audio capacity was never needed and most thought it was often essential. Pomfret (1978) points out that video seemed to be regarded as less essential than the interactive audio link.

It appears that about a quarter of the participants actually used the microphones at some point and nearly half of these talked to sites other than St. John's (i.e. to people they could not see). The level of use of the interactive facility did not change much as the project progressed. Although participants felt that individuals at other sites tended to monopolize the microphone more than those at their own site this was not a significant problem. Only 15% of the participants felt that the microphones were being extensively monopolized.

Participants felt they were encouraged to join in the discussions and acquired some feeling for how those at other sites were reacting. However, they did experience some difficulty interacting with those at their own site even though they felt the system allowed as much spontaneity as a conventional face-to-face course. They sensed that much of the two-way communication was carefully planned and that sessions were seldom altered as a result of participant interventions. Nevertheless such changes did happen more often towards the end of the broadcast period and only one participant in ten thought that the majority of sessions were too structured.

It is interesting to compare this assessment of interaction in the Telemedicine project with the UQ results. Because of the differences between the experiments and between questionnaires (UQ questions were in French with a 5 point scale, MUN questions were in English and used a 4 point scale), these comparisons obviously cannot be pressed too far, but the similarities are striking. UQ participants felt a somewhat greater closeness to other sites although sessions were judged less spontaneous and more structured than in the Telemedicine project. However,

interventions seemed to change the course of sessions more often at the UQ. But, these differences are minor. The response pattern which emerged in the surveys was essentially similar in both cases.

3.2.8.5 The Comparison with Face-to-Face Classes

Comparisons with face-to-face events were unfashionable in UQ communications circles and only one question in Tremblay's (1978) report can be compared to the questions asked in the Telemedicine project. Pomfret himself critiques gross comparisons of instructional methods but includes a question comparing the satellite broadcasts with face-to-face instruction out of deference to tradition. Comparison of the two reports suggests that only 20% of UQ participants found grasping material presented by satellite more difficult than in face-to-face sessions. The mean response to a similar question in the Telemedicine project (3.4 on a scale of 4) indicates that most Newfoundland participants found the satellite sessions harder to understand. However, since Pomfret states that "in terms of understanding the means suggest that conventional classes had at best only a slight superiority over satellite classes" this difference should not be laboured.

In response to the other questions inviting comparisons to face-to-face classes Telemedicine participants showed no clear preference either way. Pomfret concludes that, although slight changes in opinion during the project tended to be more favourable to conventional classes, "since broadcast quality varied somewhat, these scores must be taken as a very high endorsement of the satellite system . . . . From the perspective of the user, satellite classes were a highly acceptable and desirable forum for learning".

3.2.8.6 User Receptivity

An interesting feature of the Telemedicine evaluation was the measurement of change in user receptivity during the life of the project. Pomfret used his instruments to measure receptivity under three headings: general feelings about the project, preference for the satellite over face-to-face classes, and use of the communication system in the future. The data revealed that "absolute receptivity remained reasonably high although in terms of trends, a decrease did occur" over the life of the project.

One set of responses presents an interesting contrast with the UQ results. We shall simply present the data and the evaluators' comments on it.

Telemedicine

Question: I would like to use this type of communication system for taking similar courses

	Mid-Broadcast	Post-Broadcast
1 Never	3%	9%
2 Sometimes	40%	35%
3 Often	33%	31%
4 Always	24%	25%
	N = 190	N = 193

"an overwhelming number of respondents would like to use the satellite system again in the future". Pomfret (1978)

UQ

Question: Would you be interested in using this communication system for the same purposes?

Yes, certainly	++	44%	
	+	21%	
	0	21%	
	-	14%	
No, not at all	--	0%	N = 756

". . . one can summarize the opinion of the average user as follows: . . . . As for using (the system) regularly for the same purposes . . . Well, yes, perhaps." Tremblay (1978).

Of key relevance in terms of Pomfret's interest in implementation were the factors which affected user receptivity. Statistical analysis showed that, of the indicators studied, only felt participant status correlated with receptivity. In other words "users who felt more like participants than observers during the broadcast period tended to increase their overall support for the project, tended to come to view it favourably with respect to face-to-face interaction, and increased their willingness to continue to use the system in the future". A preliminary analysis showed that pre-implementation participation and the clarity of an individual's knowledge of the project had, in turn, an influence on felt participant status.

3.2.8.7 Instructors' Perceptions

The Telemedicine project differed from the other Hermes projects in that it involved a large number of different instructors (44). Nearly all instructors were interviewed and asked to complete a questionnaire.

The results showed that users were considerably more receptive to satellite classes than were the instructors. Sixty-two percent of instructors preferred face-to-face classes (25% for users) and only 7% preferred satellite classes (27-34% for users). However, instructors felt that the satellite system had much potential for improving the provision of health care in the province. They believed that greater exposure to the system and two way video would lead to much improvement.

3.2.8.8 Cost-Benefit Analysis

Although we examine the economics of satellite education elsewhere it is appropriate here to summarize the results of Pomfret's study. He stresses the limitations of the study, notably that he counted only space sector costs ($1,000 per hour) in his calculation of the costs of satellite courses and looked only at the broadcasts for doctors (since costs of existing non-satellite CME sessions could be calculated for this groups). He concludes "in terms of continuing education programmes, it appears that unless satellite costs drop drastically, attendance will have to increase dramatically in order to render costs manageable . . . In order to accomplish this it will be necessary to aim the programs at groups other than physicians" (Pomfret, 1978).

3.2.9 Conclusions and Recommendations

3.2.9.1 From the Evaluators' Perspective

The evaluation report of the Telemedicine experiment can be summarized in one sentence. "All available data indicate that, as a delivery system, the project can be considered a success by any criteria imaginable, save possibly that of costs" (Pomfret, 1978).

Pomfret recommends that:

1) Future projects should aim at audiences other than doctors. Doctors cost more to serve, are less receptive and have more CME alternatives than other health care professionals.
2) Participants should be involved in project planning or, at least, kept informed.
3) Further upgrading of broadcast and instructional quality is not a key priority.
4) Sessions should be shorter than 90 minutes.
5) Means must be found to encourage instructors to take part in such projects.
6) Careful attention should be paid to ensuring that broadcast schedules are compatible with participants' working schedules.
7) A two-way audio capacity is important. This does not mean everyone has to use it. Too great a stress on fostering interaction may have negative consequences.
8) Every attempt should be made to make participants feel like participants and not like observers.
9) Avoid an 'either-or' mentality and combine satellite broadcasts with other forms of continuing education.
10) Emphasis should be placed on the social technologies that encourage and facilitate people's attendance at the broadcasts.

3.2.9.2 From the Experimenters' Perspective

House and McNamara (1978) include Pomfret's summary in their own report and add the following points:

1) Telecommunications have a potential role in the education of health professionals and in community health education in remote areas. Although this project was conducted by satellite it could, in principle, have been carried out with terrestrial systems.

2) Agencies should make funds available to experimenters for further work but it is important to clarify at the outset of a project the different interests of funding agencies, experimenters and systems developers.

3) Future experimenters should have a comparative research design in order to clarify the relative merits of different technologies.

4) Further research in telemedicine should involve health care professionals and should relate telemedicine to current research in health care delivery.

5) All those who took part in Memorial University's telemedicine project on Hermes are anxious to carry on what they started and to continue to work together.

3.3 The Carleton University - Stanford University Curriculum Exchange

3.3.1 Background

An international project with three quite different partners, this experiment combined both technical and educational objectives. Planning began late in 1972 between Carleton University and the two United States institutions; Stanford University and the Ames Research Centre (NASA). The resulting project was a complex administrative, technical, and educational undertaking.

A brief examination of each of the partner's interests will provide some understanding of why these three disparate institutions joined to undertake this project. Briefly, the explanation is that a number of individuals at these three institutions had strong interests in communications technology and research. In addition there was an extended network of personal contacts among many of these same individuals extending back to their days at University. And, each of the institutions involved had a particular interest in some portion of the experiment.

At Carleton University the Faculty of Engineering is active in electrical engineering, especially electronics and systems technology. A specialized facility, the Wired City Laboratory, is located within the Department of Systems Engineering and Computing Science. The laboratory provides facilities for the interdisciplinary study of mediated communications between both individuals and groups. The research conducted has involved both technical and educational objectives and combined electrical engineers working with social psychologists. Both video teleconferencing and educational communications have been studied at the laboratory. The facility provides specialized personnel as well as equipment. Drs. Donald A. George and David C. Coll provided

active leadership in the activities of the Wired City Laboratory. They were also leaders in Carleton's portion of the curriculum exchange project. And the Wired City facilities were used for the Hermes Project at Carleton. The opportunity to participate in the satellite project was viewed as an natural extension of the laboratory's activities.

The Ames Research Centre was actively engaged in research to develop a digital video compression system. Dr. Dale R. Lumb was in charge of the research and viewed the Hermes project as an ideal opportunity to test an application of the experimental video compression technology. The Ames Research Centre and two commercial firms, working under contract, constucted the video encoder-decoder and the communications modem required to process the video signal. The Hermes project was a relatively minor undertaking for the Ames Centre and involved some half-dozen staff members of the five to six thousand employees. In addition to providing the technical components required for the video compression experiment, the Ames Centre also assumed overall management and coordination for the Hermes experiment. In particular, it provided a major communications link between Carleton and Stanford University.

Stanford University originally became involved through Drs. Edwin Parker and Heather Hudson of the Institute for Communications Research and Dr. Alan Peterson of the Engineering Faculty. Early plans at Stanford called for experimentation with alternative forms of presentation in order to determine the strengths and weaknesses of a given presentation format with respect to the interactive, TV-based, satellite system.

The Stanford Instructional Television Network was also involved. This network, which has been in operation for about ten years, was designed to serve off-campus students and is used to deliver primarily engineering courses. The ITV system uses specially designed classrooms to originate the lectures on campus and the off-campus students attend the lectures via television, usually at their place of work. Both classroom and off-campus students have an audio return system to ask questions of the professor during his presentation. The system uses specialized equipment and is operated by professional staff.

Although early plans assumed the involvement of Stanford's Instructional Television Network, the Director, Dr. Kenneth Down, was not part of the early planning process. However, beginning early in 1976, Down oecame the chief administrator and main organizer for the Stanford part of the project. He continued in this role throughout the project, working on an overload basis and without any financial support. Without the involvement of Down and the ITV network, the curriculum exchange between the Carleton and Stanford engineering faculties would have been virtually impossible.

Planning for the project extended over approximately a four year period. After a number of iterations and changes the plans were submitted to, and eventually approved by, both NASA and the Department of Communications, th. joint partners in the Hermes satellite project. By the time that the actual curriculum exchange started during September, 1976, many changes had occurred in both the plans and the major characters involved with the project. These are chronicled by George (1977b) and Strover (1978) and illustrate some of the problems involved in the evolution of a complex, inter-institutional, international, multipurpose project. That the project even reached the starting gate is a major tribute to the perseverance of the persons and institutions involved.

3.3.2 Description of the Project

This summary describes the project which was actually implemented and does not attempt to provide an historical overview of the various stages of project development. It must be noted, however, that the project implemented was a considerably compromised version of the original plans. Reports by George (1977a, 1978) and Strover (1978) describe the developmental context in detail. Also, the description which follows will concentrate on the educational part of the project. The technical achievements of the video compression system will be largely ignored except when these had a direct influence on systems performance and consequently effected the curriculum exchange process.

The general objective of the Carleton-Ames-Stanford experiment was to test the development of an all-digital communications system using the Hermes satellite for the exchange of courses. The specific goals of the experiment, as stated by George (1978) were to:

1. demonstrate the ability to expand the scope of instruction by sharing classes between universities that have different emphasis and orientations,
2. devise and evaluate a variety of techniques for the presentation of remote instruction, feedback, and student interaction for the user aspect of the curriculum sharing experiment,
3. experiment with diverse techniques and styles of programming to determine cost-beneficial methods of using a satellite link for curriculum sharing,
4. develop strategies for resolving administrative and class management problems created by curriculum sharing between diverse universities. Problem areas that have been identified include course accreditation, non-concurrent class terms, scheduling across time zones and classes with different time durations,

5. develop and demonstrate a cost-effective video compression system in conjunction with efficient channel coding and modulation,
6. evaluate the subjective quality of video compression techniques as applied to this teleconferencing application,
7. demonstrate the effectiveness and practicality of the proposed channel and source coding techniques in reducing satellite bandwidth and power requirements for video users,
8. determine the effects of rain attenuation and other perturbations of the proposed high data rate digital link at 12-14 Ghz. (pp. 4.5)

Table I summarizes the courses exchanged, the hours of instruction per week, and course enrollments.

TABLE I

Carleton University-Stanford University Curriculum Exchange

ORIGINATING UNIVERSITY	COURSE TITLE	HOURS PER WEEK	NUMBER OF STUDENTS* AT CARLETON	STANFORD
FALL TERM:				
Carleton	Digital Systems Architecture	2.5	32	18 (5)
Carleton	Computer Communications Systems I	2.5	30	29 (11)
Stanford	Management of Research Institutions	1.75	20	36
Stanford	Statistical Signal Processing	2.5	5	70
Stanford	Information Systems Seminar	1.0	variable	
WINTER TERM:				
Carleton	Computer Communications Systems II	3.0	?	2
Stanford	Data Structures	3.0	30 (20)	127

*The numbers in parentheses indicate the number of students who completed the course.

In addition to the courses a number of special teleconferences were held among the experimenters to discuss technical, administrative and evaluation problems (George, 1978, Appendix XI; Strover, 1978). Two-way audio/video was used for the teleconferences. This permitted both visual and verbal contact between the participating groups. Two other projects were TI-NET, a demonstration and evaluation of a computer communications network, and a simulated negotiation game conducted as an experiment in communications (George, 1978).

3.3.2.1 The Satellite Delivery System

Using the video compression system, Carleton and Stanford were linked via Hermes to allow two-way simultaneous black and white video transmissions each with an audio return. Audio echo suppressors were used at each ground station to minimize the effect of the satellite "echo". Special classrooms were used at both locations. These are described in detail by both George (1977a) and Strover (1978). For the purposes of this overview, the installations can be described as technically sophisticated. They provided specialized audio and video equipment for the students. Each student had a monitor nearby and easy access to a microphone to ask questions. Remotely controlled cameras followed the professors. Lecturers at Carleton also had access to a video disc containing graphics material that could be displayed on command.

3.3.2.2 The Videotape Curriculum Exchange

The curriculum exchange experiment was almost still-born for reasons which were beyond the control of the experimenters. Briefly, Hermes had suffered a major component failure during an early eclipse period and DOC-NASA wanted to ensure that problems

were identified and solved before risking satellite operations during another eclipse. This resulted in a shut down of Hermes from August 30 - October 18, 1976.

In order to fit the course schedules into the fall terms of the two universities, plans were made to exchange videotaped lectures during the eclipse period. The results of this plan were disastrous. Videotapes arrived at both ends late and out of sequence. Texts and other course materials were delayed, lost, or held up in customs. The effects on the classes were predictable. At Stanford thirty-one of the original forty-seven students who enrolled dropped out before the satellite based portion of the exchange began. At Carleton there was ". . . a noticeable diminishing of enthusiasm toward the entire project . . . " (George, 1978, p 17).

It is impossible to fully appreciate the total impact of this period on the remainder of the project. However, it seems apparent that it severely limited the possible educational benefits of the curriculum exchange, especially from the perspective of participating students.

3.3.2.3 Project Costs

Carleton proposed an estimated budget of $201,650 distributed among the following major allocations:

Personnel and travel	$105,150
Equipment	73,500
Overhead	23,000
	$201,650

Of this Carleton was to contribute $132,100.

The financial resources actually obtained for the project totalled $135,000. In addition Ames absorbed the research and development costs for the signal processing equipment. Also, many of the personnel at Carleton donated substantial amounts of their time and expertise on an overload basis.

DOC was an important source of funding at Carleton. The Wired City Laboratory was originally developed with the help of DOC research contracts. $62,000 was obtained from DOC to support Carleton's involvement in the Hermes project. In addition DOC provided and funded important elements of Carleton's transmitting station.

Carleton University contributed $65,000 for equipment purchases, $3,000 to allow for reduction in teaching loads by participating professors, and "several thousand dollars" for supplies, equipment, travel, and general overhead. IBM also contributed $5,000 towards the project (George, 1977a).

Ames Research Centre was responsible for the development, testing, and implementation of the video compression system. Projected costs were $65,000. However, Strover (1978) estimates that the total actual costs incurred by Ames were about $142,000. Copies of the equipment for Carleton cost about $80,000. An additional $100,000 was spent on the transmitting station which "was designed for capabilities beyond those needed by the CTS (Hermes) experiment" (p 50). No estimate is available for the project management and overhead costs absorbed by Ames.

Stanford's Institute for Communication Research was intended to be primarily responsible for the curriculum sharing programming, experiments with presentation formats, and the evaluation of the experiments. Funding was to be obtained from the Department of Health, Education and Welfare (HEW). However, all attempts to fund the Stanford projects externally were unsuccessful. As a result, the experimental plans were severely attenuated. Major responsibility for the project also shifted from Dr. Parker and the Institute for Communication Research to Dr. Down and the Stanford Instructional Television Network. Dr. Peterson of Stanford's engineering department helped organize the curriculum exchange. Stanford's entire contribution was funded indirectly with the major weight falling on the ITV system and its administrative and technical personnel (Strover, 1978).

3.3.3 Evaluation of the Carleton-Stanford Curriculum Exchange

Both Carleton and Stanford planned to evaluate educational aspects of the curriculum exchange. Ames was primarily responsible for evaluating the technical video compression system. In addition elements of the evaluation plan prepared by the DOC educational evaluation team were included.

As a package, the evaluations aimed at producing information about:

- the technical quality of the video compression system,
- an assessment of using the system by student and faculty,
- the effectiveness of variations in the presentation of material and interaction,
- suitability of class management and administrative procedures,
- projected economic viability of an operational satellite-based system, and
- policy implications for an operational system.

Explicitly excluded from the evaluation plans were any measurements or comparisons of learning "effectiveness".

George (1977a) listed seven main techniques planned for Carleton's part of the evaluation. These were:

1. evaluations of video taped lectures,
2. student attitude questionnaires,
3. interviews,
4. operators' logs, records and technical measurements,
5. student learning performance reviews,
6. a teleconference experiment, and
7. economic and operational evaluations.

Each of these techniques was selected to address one or more of the specific goals of the experiment as enunciated by George (1978). Details of the questionnaires, interview checklists, and logs used together with the procedures used in their administration are also described in the above report.

At Stanford the original interest was in studying variations in styles of presentation. The following questions listed by Strover (1978) illustrate the early focus of plans:

a. Is there any meaningful difference in quality of the picture as a result of using digital compression?
b. How effective is two-way audio? Do students tend to make use of the capability? How important is it to their learning ability and their feeling of participation in the class?
c. What is the value of two-way video, particularly for student counseling and problem sessions?
d. Do viewing students feel more or less comfortable if they can also see other students in the classroom with the professor giving the lecture? Does the flexibility of two-camera coverage improve instruction sufficiently to offset increased cost? Does a front camera showing the audience make a significant improvement?

e. What techniques are effective for follow-up of televised lectures, including student assignments, classroom experiments and demonstrations, problem sessions?

f. Is dialogue on a course subject between professors and students at the two universities an effective way to make television more 'real' and therefore acceptable to students?

g. How much more effective is a lecture via television if prepared with the television audience in mind? For example, does frequent explication by film (- of a demonstration, perhaps with a time-lapse involved, of a historical event; of an interview - with an expert - on the subject; of animated information) serve to improve student interest and retention? (pp 21, 22).

However, when attempts to fund the Stanford project were unsuccessful the focus was shifted from conducting an experimental project to simply offering courses, in standard lecture mode, to students at Carleton. The procedures adopted were largely identical to those in use on Stanford's ITV system. In fact, most courses had an off-campus audience at Stanford who participated via the ITV network. Stanford's evaluation focussed on the planning, management, and administrative features of the project. Cost categories to be considered in operating future similar projects were also identified.

Two questionnaires were administered to students. These were the 'Questionnaire for Satellite Courses' developed by Sharon Strover, Department of Communications, Stanford and the 'User Impact Questionnaire' developed at the Wired City Laboratory. In addition some students were interviewed. Details of the Stanford evaluation are provided by Strover (1978).

Three teleconferences held on November 3rd, 1976, January 25th, 1977, and February 8th, 1977 also dealt with aspects of the project evaluation (George, 1978, Appendix XI).

3.3.4 Evaluation Results

The curriculum exchange began by mailing videotapes from Carleton to Stanford and vice versa. This exchange "turned out to be an unmitigated disaster" (Hoffman and George, 1977, p 106). Details of the problems encountered are given by George (1978) and Strover (1978). The simple explanation is that no aspect of the videotape and materials exchange could be completed on any predetermined schedule. As a result, classes were severely disrupted, many Stanford students dropped out, and students, professors and administrators were subjected to frustration and uncertainty. While it is impossible to attribute any subsequent evaluation results directly to this inauspicious beginning, it is highly probable that it had major effects on the outcomes of the fall term curriculum exchange.

George (1978) notes some additional problems which complicated the curriculum exchange. One of these was the three hour difference between time zones. The satellite was scheduled for two hours between 6:00 p.m. to 8:00 p.m., Ottawa time, or 3:00 p.m. to 5:00 p.m. in Palo Alto. Other course related problems which had to be solved included different lengths between the fall terms at the two institutions, scheduling the satellite courses into each university's timetable, selecting the courses to be offered, and recruiting students. And, course selection difficulties were compounded by a last minute shift in departmental personnel at Stanford (George 1977a). The potentially thorny problem of reconciling marking and grading systems was handled pragmatically - each institution accepted responsibility for marking and grading its own students regardless of where the course originated. In addition Stanford provided faculty proctors for the students enrolled in Carleton courses (Strover 1978).

It is important to note that the compromises necessary to resolve the problems mentioned created a somewhat artifical context for the curriculum exchange. The resulting project "worked" because of the determination of the participating institutions to make it succeed. It demonstrated the possibilities inherent in the curriculum sharing concept, but in a contrived way. Left unaddressed and unanswered were questions of the need for the exchange between these particular institutions. As noted elsewhere (Richmond, 1977), this makes an assessment of the overall educational worth of the project difficult. These caveats should be kept in mind during the discussion of the experimenter's results and conclusions which follows.

3.3.4.1 Carleton's Evaluation

George (1978) assesses the achievement of the goals of the experiment. His findings are summarized verbatim:

1. The project certainly demonstrated the feasibility of expanding the scope of instruction by sharing classes between two universities (p 46).
2. While the circumstances of the experiment did not allow sufficient control so as to be truly able to 'devise and evaluate a variety of techniques for the presentation of remote instruction', a rather considerable variety of instructional techniques were used during the exchange . . . . The overall conclusion to be drawn is that while an instructor may, if he so desires, make very effective use of the special attributes and features of teaching by television, traditional methods are also highly effective. In all the importance of the instructor, and of his style and techniques, are not at all diminished in such teaching . . . . (p 47).

3. Circumstances and funding did not provide much opportunity to 'experiment with diverse techniques and styles of programming' but the most cursory cost considerations indicate clearly the necessity to keep the technical and production personnel to the barest minimum . . . . It was hypothesized that a working system of this type should be operable by a single technical assistant who would also handle camera switching and any other elements of television production . . . (p 48).

4. Some administrative and class management problems were not serious. Others posed more profound problems. Class accreditation, for example, was accomplished by the recipient institution recognizing the other university's course and establishing its own methods of grading . . . . Of much greater concern is the determination of courses available at the one university which are compatible with the programs of the other. In fact, a course exchange could be most successful on all grounds except this, and that would be sufficient to guarantee a failure . . . . It would seem that non-concurrent class terms, scheduling across time zones and related problems can only be resolved by working within the mutual times available and where necessary, assigning additional work to the students and perhaps providing supplementary instruction . . . . The other difficulty concerns the university schedules which are, in practice, unchangeable . . . if the student's timetables are tightly scheduled then serious and perhaps insurmountable problems will be encountered . . . . Yet

> another major difficulty . . . was associated with the effective transfer of hard copy . . . . An operational system certainly should include facsimile facilities. Finally, enough time should be scheduled to allow the system operators, the instructors, and the teaching assistants to meet in order to co-ordinate their various activities and to resolve problems (pp 48, 49).

5. An effective video compression system was developed . . . (p 49).

On the basis of these observations it seems fair to classify the project as a qualified success. Certainly classes were exchanged between the two universities for two full terms, although the number of students involved, particularly at Stanford, casts serious doubt on the perceived 'need' for the project from the student's point of view. From an institutional perspective, the project identified a number of difficult problems to be overcome in any curriculum exchange and provided some possible solutions. Finally, while the original educational objectives were severely attenuated by the realities of the project, it was demonstrated that professors, without prior media experience, could adapt to and use the system while preserving their individual teaching 'styles'.

George (1977a, 1977b, 1978) provides a detailed discussion of the various stages of the project. In addition to his general observations given above, information was also available from the evaluation procedures and from transcripts of interviews and project meetings which occurred via the Hermes system. The collected volumes and appendixes provide an intimate case study of the project and provide valuable information for anyone contemplating a similar venture.

Some additional results and conclusions, based largely on the evaluations, are summarized below:

1. Technical Operations

A persistent problem at Carleton was loss of synchronization of the compressed video picture from Stanford. This caused picture breakup with accompanying audio 'loud roar' noise bursts over the entire system. The problem was a constant source of annoyance to professors and students and existed for the duration of the project in spite of continuous attempts to 'tune' it out of the system.

Audio echo was a second problem experienced at Carleton. This was eventually corrected.

2. Student Reactions

Students found the system generally 'transparent' except for the technical disruptions noted. And students were able to learn from the system. This finding once again demonstrates that the student is typically the most robust component in a technological system. In spite of technical difficulties, a talking head lecturing method, and numerous problems in class management involving the remote students, all students who completed courses were successful.

Student attitudes towards the satellite based system were largely neutral. While many students complained about technical problems, individual professors, teaching techniques, and organizational problems, in general they indicated that they would take another satellite-delivered course if interested in its content area. The dominant attitude appeared to be that if a satellite based system could allow access to required and/or interesting content not otherwise

available they would use the access regardless of the special features or limitations of the technological system.

A noticeable feature of the courses was the marked lack of student-professor interaction. Reasons for this may have been the lecture style presentations or the technical problems experienced with the system. Whatever the reason, the two-way, interactive audio was perhaps the most under utilized capability of the satellite system during the curriculum exchange. Early plans for interactive seminars, student-professor office hours, and more intensive use of questioning and feedback techniques were largely abandoned in the press of presenting the courses. As a result the curriculum exchange occurred mainly in a 'broadcast' mode.

3. Professors' Reactions

Professors used the system primarily in their standard lecture mode of presentation. Although there were observable style differencies among the lecturers, all were able to use the technology in their preferred presentation format suggesting that "a television teaching system does not impose a particular style on the instructor" (George, 1978, p 23). Stanford professors, experienced in using the ITV network, were noticeably more 'system wise' than Carleton professors who were teaching via TV for the first time.

Carleton professors experienced an increased workload for class preparation, but noticed that they tended to cover more material in less time compared to a normal classroom. They found technical problems disrupting and tended to perceive the system as more rigid and structured than a regular classroom.

3.3.4.2 Stanford's Evaluation

Strover (1978) notes that this project focused almost exclusively on organizational and technical considerations relevant to satellite-delivered curricula. She observes that the curriculum-sharing demonstration did not consider the system's effect on learning. She laments the fact that early Stanford proposals (see Section 3.3.3) went unfulfilled primarily due to lack of funding.

A case study approach based on personal records, interviews, and questionnaires is used by Strover (1978). Her overall findings can be summarized succinctly:

"As an experiment, the curriculum-sharing effort has many problems; that the demonstration 'worked' at all was a surprise to some, given that most funds for the demonstration went for hardware and only negligible amounts were devoted to management, planning and courseware. It is thus not surprising that technically the demonstration succeeded, but that as an exercise in the pragmatics of curriculum-sharing, it left much to be desired" (p 3).

Additional findings, based on Strover's evaluation, were:

1. There was a perceived need for more direct communication between Stanford and Carleton during all stages of the project.
2. Professors would have liked the system to have two-way video to permit them to see their 'distance' students.
3. Professors had little or no input in project planning. Had they been involved, the project might have focused more on the opportunities and constraints of 'satellite teaching'.
4. Stanford students made considerable use of their proctors. Some even suggested that the proctors teach the course!

5. Students "would have liked more homework, improved technical quality, and notes in advance of the lectures" (Strover, 1978, p 44).

Strover identifies four main problem areas which emerged from the demonstration:

1. Institutional Accompaniments to the System

Materials exchanged via the mail were invariably late in arriving causing problems for students and professors alike. This mirrors George's concern (see Section 3.3.4.1) than "an operational system certainly should include facsimile facilities."

Professors displayed varying degrees of 'adaptability' to the system.

2. Technical Quality

Stanford students noted that the audio return to Carleton was frequently inoperable (although generally used when available), that Carleton's camera work could be improved, and that diagrams and written material had some problems of poor resolution.

3. Testing, Grading, and Student's Reactions

All exam and final grades were awarded by each student's "home" school and most felt this grading process was acceptable.

There were wide variations among the courses with respect to the number of tests and exams, student assignments, and overall course 'load'.

Students at Stanford relied heavily on their proctors to organize course material and select the most important points.

4. Morale and Enthusiasm

Heavy workloads (all actually overloads!) at Stanford made participation onerous for both ITV staff and course proctors and eroded enthusiasm for the project.

The initial mail videotape exchange (during the satellite eclipse period) and recurring technical problems contributed to a high drop-out among Stanford students.

Concluding observations by Strover (1978) focus on what was learned from the curriculum-exchange demonstration. These include:

1. The video compression system was generally successful inspite of some persistent technical problems.
2. Students were generally neutral in attitude towards the system although most said they would take another course via satellite if interested in its content.

   As an aside, it must be noted that this finding is based on those students who stayed with the courses. It seems fair to speculate that those who dropped out (31 out of 47 enrollments) probably rated either the course or the system, or both unacceptable and 'voted with their feet'.

3. The logistics of course scheduling, accreditation, grading, etc.. . . posed no major problems although the pragmatic, ad hoc solutions adopted would probably need to be revised for an ongoing operational project.

4. Stanford staff and students experienced increasing problems of morale and enthusiasm over the duration of the project.

5. While absolute costs for the project were impossible to determine, important cost categories, including numerous 'hidden' costs were identified.

6. Courses employed 'talking head' lectures, frequent visuals and made some use of the audio talk back facilities. However, the two-way interaction capability was relatively underutilized.

   There is an apparent need to apply instructional development technology to designing appropriate course presentation formats. This should be a priority research area in future curriculum-sharing projects.

7. Early plans were not carried through due mainly to lack of financing and numerous changes in project personnel. This resulted in a severe attenuation of the potential experimental possibilities of the project. 'Courseware' was successfully exchanged, but in a format which largely ignored many interesting experimental opportunities for studying formal variations.

8. Formative evaluation was not given sufficient attention. As a result, opportunities for improving the curriculum-exchange 'in process' were missed.

Strover's general conclusion is that:

> "the full potential of resource sharing was not tapped in this project. Further experimentation must focus on the interaction capabilities of this medium within an educational outline, evaluating obtainable results in light of other mechanisms offering similar 'results'. Hence curriculum sharing via satellite must still be phrased in terms of potential. The Stanford-Carleton-NASA-Ames effort should enter the annals, as a modest project accomplishing modest goals, focussing some unanswered questions for the future" (p. 63).

3.4 Public Service Commission of Canada: Teletraining for Personnel Development

3.4.1 Background

The Public Service Commission (PSC) of Canada has a wide ranging mandate to provide staff training for members of the federal Public Service. More than 20,000 public servants participate each year in courses delivered by the PSC mainly in the areas of professional, managerial, and linguistic training and development.

Since federal public servants are located in all regions of Canada, the PSC has utilized a variety of training methods including telecommunications. It began experimenting with interactive telecommunications in 1974 and progressed through field and laboratory trials to the Hermes experiment.

Organizationally, the PSC 'Teletraining for Personnel Development' project was a complex and well planned venture. It was also well staffed as indicated by a listing of project personnel which shows twenty-two persons directly involved under the general headings of Management, Design,

Development and Training, Learning Model Development, Internal Evaluation and Research and Engineering and Technology Development. And, since no mention is made of funding problems, this project appears to be the only one whose plans and outcomes were unaffected by funding uncertainties and inadequacies. Thus, this PSC staff training experiment provides a case study of an 'ideal' project - that is, one in which the objectives determine the nature and kind of resources required.

The PSC project was conducted with minimal interface between it and the Hermes educational evaluation team. In a real sense there was little need for contact since the project had its own evaluation team and the educational model utilized made it unique among the educational experiments. The precis of the project which follows is based entirely on published reports authored by the principals of the project. For complete information readers are encouraged to consult the original sources. These are Ryan (1977), Mendenhall and Grygier (1977), and Mendenhall and Lortie (1978).

3.4.2 Description of the Project

The satellite portion of the PSC project was the culmination of a series of studies into the use of interactive telecommunications, audio only and audio/video, for staff training. Beginning in 1974, the PSC conducted field trials involving language and financial seminars using the public telephone teleconference system. These were followed by laboratory studies and simulations at the Department of Communications - Public Service Commission Interactive Tele-education Laboratories. Results of these studies set the stage for the Hermes satellite trials.

Beginning on April 26, 1977, satellite sessions were held every Tuesday and Thursday, 1:00 p.m. - 3:00 p.m., Ottawa time. Two sessions of the course were held; the first from April 26 - May 19 and the second between May 24 and June 16. A control group was given the same course in a face-to-face mode during the period May 25 - June 20.

Five separate learning centres were equipped with an interactive audio/video system and linked via the satellite. Four rooms were located at Memorial University, Newfoundland, and the fifth in L'Esplanade Laurier, Ottawa.

3.4.2.1 Objectives

The objectives of the Staff Training by satellite project were to:

1. develop educational telecommunications as an educational tool, that is, from a one-way teacher-centred communications system to a multi-way learner-centred system.
2. explore, through the development of learning methods via satellite, new or improved methods of professional development for the public service.
3. investigate the possibilities of providing managerial or language training for public servants via satellite technology thus allowing them to remain in their home offices or home location while participating in courses.
4. study those aspects of human telecommunications which may encourage or hinder learning.

3.4.2.2 The Learning Model

An innovative student-centred, andragogic learning model was developed and used for the project. Based on the assumptions that man is self directing and that learning is an individual, inner-directed process, the model employed the teacher as an animator, facilitator, and resource person. The model was developed to take advantage of the two-way capability of the satellite system by promoting a maximum of interaction among participants and locations.

Since the learning model developed by the PSC was the only major innovation in teaching/learning practice attempted in the Hermes educational projects, it is worth while to examine it in some detail. The model was developed as a result of the PSC laboratory trials which "showed some of the major deficiencies of applying the traditional learning and teaching approach, and confirmed the need to develop an educational learning model more closely matched to the needs of the adult learner in a mediated situation" (Mendenhall and Lortie, 1978, p 164).

Based on evidence that interaction, the exchange of information among learners, is a key element in a successful mediated learning experience, the model assumed the following conditions for interaction:

1. the traditional roles of the teacher, and learners, must be redefined;
2. responsibility for learning must rest with the learners;
3. learning behavior should be appropriate to the characteristics of the technical system used for interaction.

The model was developed by first defining a set of propositions or principles, recommending roles for the teacher and learners consistent with the principles, and then describing behaviors appropriate for the roles. Each stage is outlined below:

Principles:

1. Man is basically self-directing.
2. Adult learners are oriented towards solving problems in real life situations.
3. Adult learners tend to organize their learning into self-directed projects.
4. Learning is an individual, internal, process involving the whole person.

Roles for the Teacher:

1. Animator and facilitator.
2. Content and process resource person.
3. Change agent.
4. Promoter of greater awareness and personal growth.
5. Assists learners in learning how to learn.
6. Learner.

Roles for the Learner:

1. Responsible for his learning.
2. Responsible for determining his needs, goals, and educational objectives.
3. Develops his learning skills and awareness of needs, potential and interests.
4. Active inquirer.
5. Source of learning resources.
6. Self evaluation.
7. Content/process resource person as appropriate.

Behaviors for Course Preparation:

Ten steps, intended to provide learner involvement, early interaction among participants, and some acquaintance among students, are listed for course preparation. These are:

1. A needs survey of potential learners.
2. Selection of a course topic based on the needs analysis.
3. Advertising and recruitment from among the potential learners.
4. Preliminary definition of each learners learning objectives relative to the course topic. This is an iterative process which is repeated and leads to more specific objectives over time.
5. Learners catalogue their own resources related to the course topic and may recommend resource persons.
6. The teacher assembles a fact sheet on each learner, including his learning resources, for distribution to all learners.
7. Preparatory course documents are made available to learners to:

   - answer potential expectations;
   - increase learners' self-confidence;
   - facilitate the clarification and specification of each learner's objectives prior to class sessions.

8. Learners are invited to find their own documents and references and exchange these among themselves and the teacher.

9. The teacher analyzes the students' learning objectives and draws up a proposal for a tentative session plan which is sent to students for discussion and negotiation.
10. Based on the learners' objectives and subject matter requirements, the teacher prepares successive content blocks with accompanying learning activities. Course development is a continuous process which only culminates at the first class when a session plan, schedule, and content blocks are finalized. Even then, the possibility of further renegotiation at any subsequent session exists.

Behaviors for Class Sessions:

First Class:

1. Learners introduce themselves, socialize briefly, and become acquainted with the learning centre (classroom) environment.
2. The teacher orients the learners to the audio-video learning system and encourages them to use it for a while and then decide on the necessity and nature of a procedure for interaction.
3. Learners hold a group planning session among the learning centres for the remainder of the session. This reviews and reaffirms or modifies the course plan and allows the learners to become acclimatized to the technical system before beginning work on 'new' content.

It is important that the teacher utilize the first session to emphasize his/her role as facilitator. Important behaviors to be displayed include:

- listening attentively to learners' interventions;
- reformulating questions and statements to check for understanding as required;
- refraining from elaborating to much in order to stimulate personal inquiry.

Ongoing Classes:

The teacher maintains a role of animator and facilitator and promotes self-directed learning among the learners. Essentially, this consists of promoting discussion among all participants by:

- guiding;
- stimulating thinking;
- facilitating communication;
- promoting cooperative interpersonal relations.

Between Classes:

Small group meetings for self-help or individualized tutorial work may be promoted between classes. Normally, participation will be voluntary.

3.4.2.3 The Course

Based on a needs survey, a course, "Long-range Planning in Government", was developed. The course was delivered four times during the project; once in simulation, twice by satellite, and once in a face-to-face mode. For both satellite sessions the course directors were in the Ottawa location.

Learners were recruited by project staff, Regional Operations and the Registrar's Office of the Staff Development Branch.

Table I summarizes course locations, enrollments and delivery periods.

TABLE I

SATELLITE EXPERIMENT TIME-TABLE

January 1977	April-May 1977	May - June 1977	
• 4 locations • closed circuit TV • 16 hrs over 3½ days • 16 federal public servants	• 4 locations in St. John's • 1 location in Ottawa • TV satellite link • 16 hrs over 4 weeks • 20 federal public servants	• 4 locations in St. John's • 1 location in Ottawa • TV satellite link • 16 hrs over 4 weeks • 11 federal public servants • 6 provincial public servants • 3 university administrators	• 1 location in Ottawa • face-to-face • 16 hrs over 4 weeks • 20 federal public servants

3.4.2.4 The Learning Centres

Each learning centre was equipped with special video multiplexing technology designed to transmit four video images on a single channel. A maximum of five learners occupied each learning centre.

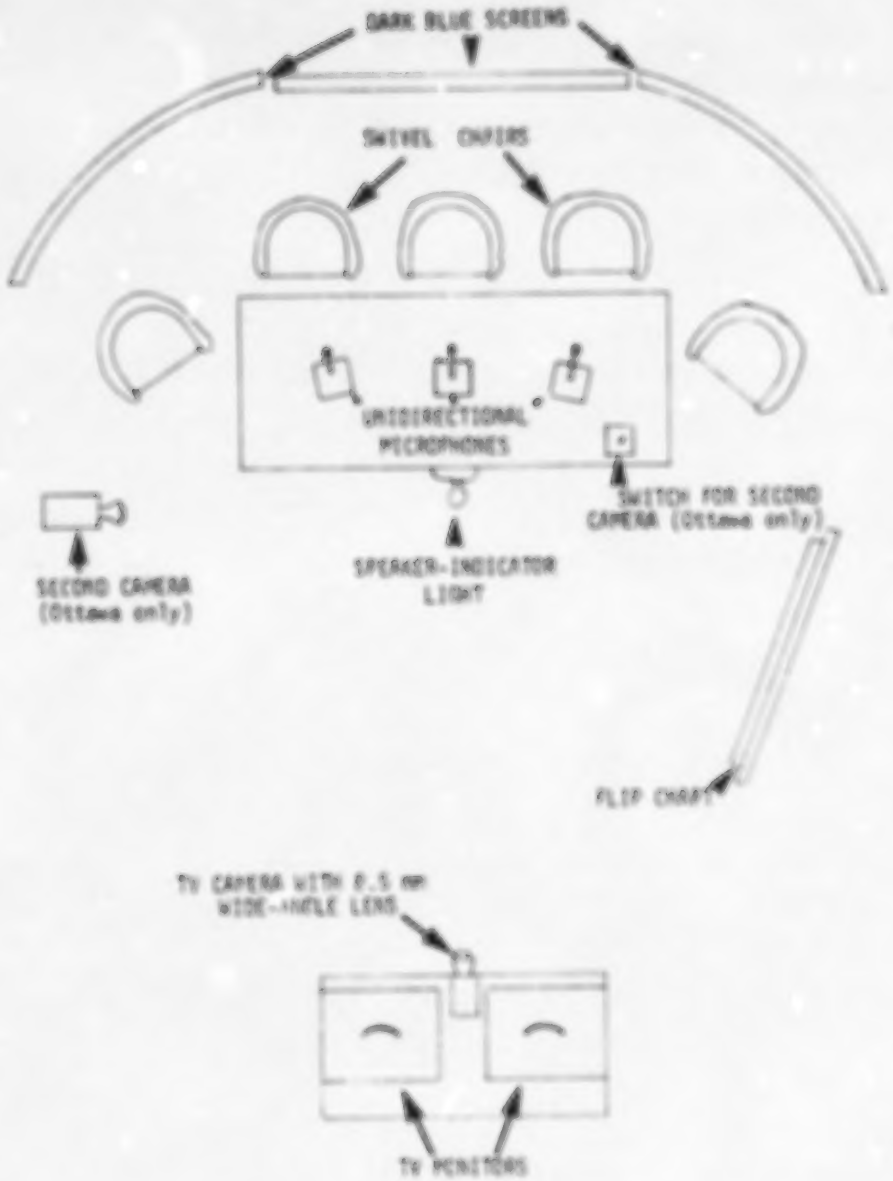
Equipment at each site included a fixed TV camera with a wide-angle lens, four TV monitors, an open microphone system with three microphones, and headphones for each participant.

The Ottawa learning centre was equipped with a second camera and a flip chart for transmitting graphics information.

The layout of each centre was designed to maximize learner participation by creating a comfortable, convenient configuration. To quote the experimenters: "The centres reflect an underlying principle of the project: technology should serve learning and not vice versa" (Ryan, 1977). Figure 1 illustrates the layout.

FIGURE 1

LAYOUT OF A LEARNING CENTRE



(from Ryan: Teletraining for Personnel Development)

3.4.2.5 The Satellite System

Audio and video signals originating from the learning centre at Ottawa were transmitted via microwave to the DOC 9m terminal at the Communications Research Centre, Shirley Bay. The signals were then transmitted via the Hermes satellite to a 3m terminal located at Memorial University and distributed via the Educational Television Centre to the four campus learning centres.

Return signals, with the video from the four Memorial learning centres multiplexed into a single channel, reversed the route.

3.4.2.6 Project Costs

Jarmasz (1977) summarizes total costs for the PSC satellite courses as follows:

Salaries:

- satellite team (August 1975 - June 1977)	$100,643
- course instructors	32,914
- support staff	102,199
Classroom costs	960
Supplies, photocoping, etc.	2,457
Technical equipment	25,527
Rental charges	22,480
Travel	8,829
Sub-contract	9,712
	$305,681

3.4.3 Evaluation of the PSC Project

Four separate, but related, evaluation studies were conducted by PSC project evaluators. Each is described in detail in the Project Evaluator's Report (Mendenhall, Grygier, and Jarmasz, 1977).

3.4.3.1 The Evaluation of a Mediated Training Experiment

Learning via the Hermes satellite system was compared to learning in a face-to-face control situation for the "Long-range Planning in Government" course. Using the Eysenck Personality Inventory, EPI, Form A, the learning of extroverts and introverts in the satellite and face-to-face situations was also compared.

Two research hypotheses were tested:

1. That there would be no significant differences between the learning results of the satellite (experimental) and face-to-face (control) group.
2. That there would be no significant difference between the learning results of extroverts and introverts.

Results of two-way analyses of variance confirmed the null hypothesis in both cases. These results are interpreted as indicating that people learn as well by satellite as they do in the face-to-face situation. Further, there is no evidence to support the theory that extroverts, as measured on the EPI, should perform significantly below introverts on learning tasks.

3.4.3.2 The Effects of Learning-Style Preference on Learning, Satisfaction, Participants' Interaction and Attitudes to the Medium

Participants in the two satellite course sessions (experimental) and the face-to-face (control) group were classified into two groups on the basis of their responses to a pre-course questionnaire defining their preferences regarding the role of a learner and the role of a teacher. Given the learning model employed, it was hypothesized that participants preferring a student-centred approach (as defined by the questionnaire) would:

1. do better on a learning test at the end of the course;
2. be more interactive (as measured by number of interventions) during course sessions;
3. be more satisfied with the sessions and the medium.

Results of the statistical analyses conducted did not support any of the hypotheses. The evaluators conclude that learning style preference has little bearing on learning, satisfaction, or participant interaction for the Long-range Planning in Government Course.

3.4.3.3 The Effects of Medium on Behavior, Attitudes, and Satisfaction of Learners

Two of the major objectives of the PSC satellite project were to:

1. explore new methods of professional training through the development of a mediated learning methodology;
2. study aspects of interactive human telecommunication which facilitate or hinder learning.

As an experiment designed to address these issues, this study compared satellite (experimental) and face-to-face (control) groups in terms of behavior, attitudes, and satisfaction with the learning model developed for the project. Five hypotheses were tested:

1. There will be no significant difference in satisfaction with an evaluation of the learning sessions between participants attending mediated (experimental) sessions and those attending face-to-face (control) sessions.
2. Participants in the experimental group will be less critical of the teaching approach as practiced than will those in the control group.
3. Among the experimental group, those using a multiplexing system (Ottawa) will be more critical of the equipment and less satisfied with the sessions than will those not using such a system (Memorial learning centres).
4. The degree of interaction, as measured by the number of interventions, will be greater among the control group than the experimental groups.
5. The proportion of questions to total interventions will be greater among participants attending mediated sessions than among those attending face-to-face sessions.

Results obtained were as follows:

Hypothesis #1:

Participants, on the first satellite course were significantly (.01 level) more satisfied than participants in the face-to-face course. The difference was in the same direction, but not statistically significant, for the comparison between the second satellite group and the control group.

Hypothesis #2:

No significant differences were found between the experimental and control groups when compared on 'criticalness' towards the teaching approach.

Hypothesis #3:

When the Memorial and Ottawa groups are aggregated, a statistically significant (.01) difference is found on the Attitude towards Equipment Scale indicating that those participants using the multiplexing system were more critical of the equipment.

Significant differences (.01 - .02) were also found on the Satisfaction Scale for a comparison between the second satellite group and the control and on the Attitude towards Equipment Scale between the first satellite group and the control. In both cases the control group ratings were lower (more critical) than those of the experimental group.

Hypothesis #4:

Although differences between the experimental and control groups were not statistically significant, they consistently indicated high participation scores for the control groups.

Hypothesis #5:

Results indicated no significant differences between experimental and control groups when comparing the proportion of questions to total interventions.

On the basis of the results, the evaluators conclude that:

1. The theoretical learning/teaching model was well implemented.
2. The learning/teaching model was well suited to the needs of the adult learner and satisfactory for both satellite and face-to-face conditions.
3. The interactive video system was well adapted to the learning/teaching model, to the course content, and to active student participants.
4. The mediated satellite video system is as effective and as well appreciated by participants as the face-to-face situation when used for task-oriented training.

3.4.3.4 Cost-Effectiveness Analysis of the Satellite Experiment

Using a model developed by Gallup (1977), cost-effectiveness comparisons are made between the satellite and face-to-face learning situations on the basis of the following formulas:

$$e = \frac{A \times S}{T \times C}$$

where: e = course effectiveness based on achievement measures
A = the sum of all test scores by students
S = the total number of students completing both pre- and post-tests
T = the total amount of time students spend in a course, both in and out of class
C = the total operating costs for the course.

By assuming that Total Course Effectiveness, E, is the sum of the effectiveness for the alternative course sections, i.e. $E = e_1 + e_2 + - - e_n$, a relative effectiveness can be determined for each alternative by the formula

$$Re_1 = \frac{e_1}{E} \times 100$$

The following values were calculated by combining the two satellite course sessions and comparing them to the face-to-face session:

$A_s = 263$ $\quad$ $A_{ff} = 94$

$S_s = 27$ $\quad$ $S_{ff} = 9$

$T_s = 750$ $\quad$ $T_{ff} = 238$

$C_s = 305,681$ $\quad$ $C_{ff} = 134,786$

$e_s = 0.000031$ $\quad$ $e_{ff} = 0.000026$

$$Re_s = \frac{0.000031}{0.000057} \times 100 = 54.39$$

$$Re_{ff} = \frac{0.000026}{0.000057} \times 100 = 45.61$$

The evaluator concludes, on the basis of this result, that the relative effectiveness of the satellite course sessions are greater than the face-to-face session. He adds the caveat that the costs used for the satellite sessions do not include satellite or terristrial system costs which would have to be considered in an ongoing system.

3.4.4 Recommendations

Based on a survey conducted in the Staff Development Branch of the PSC, managers identified the following educational needs which a satellite system might fill:

1. training and developing regional officers;
2. job-coaching and training for civil servants in remote areas of Canada;
3. training Indian and Inuit civil servants in management skills;
4. providing scarce and busy human resources (experts, instructors) to regional classrooms and allowing regional resources to be used in central classrooms;
5. conducting joint projects between the federal government and other national and international organizations including negotiations on course design and resolving problems with joint venture participants.

General recommendations for developing the use of satellite telecommunications based on these identified needs are:

1. Aggregate remote communication needs of the organization (PSC) in the areas of training, administration and data transmission.
2. Determine the extent to which existing telecommunications satisfy the need.
3. Supplement existing systems by whatever additional systems are required.
4. Proceed from first project use of systems to fully operational multi-use remote communication systems in order to ensure maximum return on telecommunications investment.
5. Utilize existing free experimental communication facilities to assure the most efficient and effective utilization of human and material resources on eventual operational systems.
6. Maintain liaison with public service telecommunications user groups.

4 Observations on the Results of the Educational Experiments

This section compares some of the outcomes and discusses issues raised by the Hermes educational projects. The observations and views presented are synthesized from specific evaluation activities and more general sources including participation in DOC sponsored experimenters' and evaluators' meetings. In all cases, the views expressed are those of the authors and do not imply general endorsement by either the Department of Communications or individual experimenters or project evaluators.

4.1 Institutionalization of the Satellite Technology

In section 3.2.6.2 we noted that Dr. Pomfret's study of the implementation of a social innovation might help illuminate the problem of the institutionalization of new technology. One of our interests was to test some hypotheses made by Hooper (1975) about factors which facilitate the assimilation of new technology in educational institutions. We shall list these hypotheses and comment on them with reference to each of the satellite projects.

4.1.1 The Technology Answers Real Needs Linked to the Primary Objectives of the Institution

The Memorial University of Newfoundland Telemedicine project rates highest on this factor. Continuing medical education is a primary objective of the Faculty of Medicine and the ETV centre has an important commitment to off-campus education. In addition a needs assessment was conducted as part of the project planning.

Teletraining for Personnel Development, the Public Service Commission project, also rates highly. The PSC has a primary mandate to provide training and education to public servants scattered across Canada. Their satellite project was a natural extension of work already underway to study possible uses of telecommunications for training. Both the course content and the teaching/learning model developed were based on needs information.

The Omnibus project of the University of Quebec was unique in that it was conceptualized as an exploration of the satellite technology involving a variety of applications. As such it did not address primary objectives or needs. The Carleton-Ames-Stanford had technical objectives as its primary raison d'être. While both projects produced useful information and experience, they cannot be regarded as rating high on Hooper's 'real needs and primary objectives' factor.

4.1.2 The Technology Blends in with Technology Already Being Used

All of the projects score highly on this factor. In every instance the satellite project provided a logical progression of studies and experiences already underway.

4.1.3 The Team Responsible for Implementing the Technology is Integrated into the Institution and not a Peripheral Tack-on

While all projects established a special management structure, key persons were generally given responsibilities congruent with their normal roles. However, there seems to have been frequent confusion of roles for various participants including teachers,

students and project evaluators. This situation was probably to be expected since the nature of the overall Hermes program precluded any consideration of establishing permanent, operational organizations.

4.1.4 Serious Attention is Given to Training Personnel to Use the Technology

Both the MUN and PSC projects rate highly on this factor. In each case the operational phase was preceded by orientation and simulation activities.

Carleton and Quebec were less successful in implementing orientation and training although it must be noted that both were plagued with technical difficulties during project start-up.

4.1.5 The Institution Puts Up Some of its Own Resources in Order to Use the Technology

The PSC project appears to have been totally self financed. All of the other projects had to rely to a considerable degree on outside funding augmented by institutional allocations of funds and considerable absorbing of indirect project costs. Most key personnel donated personally by working regularly on an overload basis. That all the projects were completed in spite of resource limitations is attestation of the commitments of both the individuals and institutions participating.

4.1.6 The Technology Has High Visibility Both Within and Without the Institution

All projects achieved high internal and external visibility. The satellite technology and its educational uses obviously captured

people's imaginations. In fact the glamour of the technology appears, at times, to have deadened people's critical faculties.

4.1.7 The Use of the Technology is Evaluated

While each project was evaluated, problems with the relatively short duration of the projects, idiosyncratic methodologies, and lack of control produced more descriptive than summative evaluation information. However, the collected reports provide a wealth of information on how to (and how not to) conduct satellite projects.

4.1.8 Different Departments and Institutions Collaborate on the Project

A marked feature of all the projects was the cooperation and enthusiasm which they generated around them. And there was much sharing of problems, experiences, and information between and among experimenters. The DOC appears to have played a major role in encouraging and facilitating this cooperation.

4.1.9 The Technology Favours Reforms and Developments Already Underway in the Institution

As noted above, all the institutions were already experienced in, or experimenting with, the use of telecommunications when the opportunity to participate in the Hermes project was presented. It seems reasonable to assume that their initial proposals and eventual selection as experimenters were related to their demonstrated interest in telecommunications.

4.1.10 The Technology has High Transferability

While the satellite technology has high potential transferability, the Hermes projects were not a good test since they were of finite duration by design. Until institutions can see the possibility of continuing access to a satellite system, they are unlikely to seriously consider incorporating satellite technology into their ongoing operations.

4.1.11 Existing Equipment and Courseware can be Used with the Technology

This is very much the case with satellite distribution which is technically identical to any TV application. Hermes provided the added dimension of return audio and this interactive capability of the system was perceived as enhancing its value by all experimenters.

This brief analysis tends to support Hooper's hypotheses. The eagerness of MUN and UQ to continue work with telecommunications systems and the Anik B satellite suggests that a good degree of assimilation of this new technology has already taken place within these institutions. While the PSC project team was eager to continue development of telecommunications use, it has apparently fallen victim to fiscal retrenchment. At Carleton work in the area continues but via interfacing the ETV system with community cable television instead of satellite. Interest is still strong in satellite based curriculum exchanges and the possibilities inherent in a Canadian educational satellite consortium.

That these pioneering efforts on Hermes have had a significant impact is obvious in the number of proposals which have been received for pilot projects on Anik B. And a Canadian public service satellite users group, FOCUS, is in an embryonic stage of development.

4.2 Educational Importance of the Hermes Projects

There is general agreement that the DOC, by granting educational (and other public service) institutions free access to the Hermes satellite, created a milestone in the history of Canadian education. Whether the resultant expectations and dreams will be realized, is still a moot question. Two sets of factors are likely to be important in determining the answer. One is the combination of regulatory and fiscal policies to be developed for an operational satellite system. The second relates to how well educators are able to utilize the satellite technology. This section presents a brief assessment of the current projects in terms of the second issue.

4.2.1 Interaction

Hermes was unique in that it allowed two-way communication between distant points. Both Carleton and the PSC projects utilized a symmetrical two way audio-video system. MUN and UQ used mainly the audio-video transmit, audio only return configuration. At various times computer data, facsimile, and slow scan were also experimented with on the audio channel. The UQ project attempted to study effects of the symmetrical vs assymetrical modes of communication for different types of applications.

While none of the evaluation results were definitive, the following observations appear warranted:

1. The two-way capability of the satellite was viewed as a very important, and in some cases, an essential, feature of the system.
2. The interactive capability of the system was generally underutilized.
3. Remote sites tended to utilize the two-way capability evenly as measured by the number of interventions originating from each site.
4. Animators/facilitators can promote higher frequency of interaction.
5. Planned interaction was not perceived as too structured by participants.
6. Students generally felt that the system allowed as much interaction as a conventional face-to-face course.
7. Satellite sessions should be comparable to regular class periods in duration.
8. The two-way capability helped students feel more like participants than observers during the satellite sessions.
9. The teaching styles of individual instructors were important factors in promoting or inhibiting interaction.

4.2.2 Needs and Expectations Served

The needs analyses and orientations carried out by the MUN and PSC projects appeared to have been important in creating favourable perceptions towards the satellite experiences and in generating relatively high participation rates.

4.2.3 Increasing Access to Educational Opportunities

While it can be argued that none of these projects reached 'new' groups of students, there is little doubt that they successfully demonstrated the potential of the satellite system for bridging both geographical and psychological distance. In addition they demonstrated that a wide variety of educational applications are possible.

4.2.4 Innovativeness of Teaching/Learning Methodology

The andragogic, student-centred model developed by the PSC was the only serious attempt to develop a teaching-learning strategy tailored to the capabilities of the satellite system. Evaluation results indicate that it was successful.

Other projects appear to have conceptualized the satellite system as an extended classroom and planned accordingly. Typical formats included lectures, seminars, and panel/expert discussions all with the capability of student questions and comments. These were also judged successful.

While it is obvious that ordinary teaching-learning formats can be readily adapted to satellite systems, there is evidence that more innovative techniques can also be employed. In particular, there appears to be promise in the use of multidisciplinary teams developing 'programming'. Such teams might include a subject matter expert, an instructional psychologist, a television producer/director, a visual design professional, and an evaluation specialist.

4.2.5 Quality of the Educational Experience Provided

Evaluation results suggest that most participants found education via satellite generally acceptable, but not quite up to the face-to-face situation in quality. In some instances the students were not located in adequate facilities. For other cases technical problems with the system, especially audio, interfered with the educational process.

It is interesting to note that Stanford professors, experienced in using an interactive ITV system, were rated highly by both students and other professors for their use of the system and the quality of the resulting instruction.

4.2.6 Learner Outcomes

Cognitive learning was largely ignored in the evaluation of the Hermes project. This is understandable given the short duration and informal nature of most of the learning experiences. In the Carleton-Stanford curriculum exchanges, courses were graded by the receiving institution and grades were not compared between institutions. Thus one can only assume on the basis of students' favourable affective attitudes that they actually learned via the satellite system.

For future pilot and operational projects, learner outcomes are likely to be a major criterion for judging satellite systems performance. It is unfortunate that they received such minimal attention during these projects.

4.2.7 Impacts of the Educational Projects

At a general level the major result of the Hermes projects appears to have been an initial awakening of awareness and interest among Canadian educators of the potential of satellite systems for educational uses.

More specific impacts are difficult to identify, but it appears that the projects were successful in demonstrating:

- the reliability and useability of a satellite-based telecommunications system
- the potential effectiveness of two-way, interactive telecommunications for lessening the 'distance' in distance education
- that a satellite-based system will be acceptable to students
- that usual instructional formats can be adapted to the two-way satellite system

4.3 Administrative Considerations

It is an understatement to say that the project teams learned more from the Hermes projects than participating students. This section summarizes some of the important considerations for planning future projects and operational systems.

4.3.1 Needs Analysis

Future projects should address clearly identified needs and objectives. These should be derived from, and identified with the help of, the intended audiences for the proposed educational service.

4.3.2 Project Personnel

Project staff should be full-time, psychologically committed to the project, and have clearly defined roles and responsibilities. Key positions should have a back-up so that continuity is assured in the event that persons have to be replaced during the project.

The team concept is a good model for project management. For projects which intend to originate 'new' programming, a minimal team should probably include specialists in instructional psychology, the subject matter areas, TV production, visual design, and evaluation.

4.3.3 Project Management Plan

A detailed management plan specifying the activities for each stage of the project, milestone events, and personnel, financial, and other resources required should be prepared and adhered to or systematically modified as the project develops. Ad hoc procedures are to be avoided except in emergency situations.

The project management plan should anticipate and provide contingency plans for systems failure, site failures, and other possible exigencies.

All members of the project should be kept informed of progress and should have frequent meetings for planning and problem solving.

Training may have to be provided for certain specialized roles such as, for example, teacher aides on site, or community animators/facilitators.

Evaluation should be included as an integral part of the project management plan from the earliest stages.

4.3.4 Technical System Design

The ground based portion of the satellite telecommunications system requires careful design. It should be designed as far as possible to serve the educational objectives. For example, if audio interaction involving groups of persons is desired, then there should be enough microphones at each site to handle the maximum number of participants expected.

Other equally obvious considerations include:

- careful layout of the physical site
- providing enough monitors, properly positioned, so all participants can easily see the video portion of sessions
- checking the technical interface requirements of all ancillary equipment which may be used
- arranging maintenance and repair services or service contracts for all equipment
- providing detailed operating and trouble shooting instructions for all equipment in routine use.

4.3.5 Scheduling, Program Development, and System Preparation

Lesson plans and program formats should be determined well in advance of on-air operations. Important tasks to be accomplished during this pre-operations phase include:

- identifying and recruiting production and delivery personnel - subject matter experts, instructional psychologists and educational technologists, visual designers and graphic artists, evaluators, TV production and studio personnel, teacher aides, and site coordinators;
- preparing and testing pilot programs;
- simulation of the satellite system;

- preparing a student recruitment and public relations plan;
- acquisition of existing media materials and clearance of any copyrights;
- identifying and equipping the delivery sites;
- scheduling the delivery system.

In preparing individual programs a number of factors to be considered include:

- the amount of 'new subject matter' to be presented;
- the duration of the session - current experience suggests 1 hour or less;
- variety and change of pace during the presentation mode;
- the amount of student interaction desired;
- the balance between 'live' and 'canned' presentation;
- the balance between on-air and off-air teaching and learning;
- an etiquette for the interactive portion of the program.

Another consideration is to develop and test a contingency plan in the event of partial or total system breakdown. Experience with the Hermes projects also indicates that it is advisable to have a back up telephone system installed at all sites so that communication is possible when the satellite system is inoperable.

4.3.6 Budgeting for the Project

Developing a project budget can be a difficult task, especially for a first time effort. Not only do all cost categories need to be identified, but reasonable cost estimates also have to be produced for each category. Finally some estimate of potential cost-effectiveness or cost-benefit needs to be determined using a defensible set of criteria.

The following list defines some major cost categories. It is not exhaustive and does not make the usual capital vs operating cost distinction. It is based on a study conducted by Daniel (1977).

4.3.6.1 Satellite System Costs

- Lease of the space sector.
- Each station: lease, operating, and capital costs.
- Equipment: cameras, monitors, audio equipment, switching equipment, studio equipment, power sources.
- Maintenance and operating costs.
- Engineering and systems design.
- Site development and equipment.

4.3.6.2 Instructional Development Costs

- Material acquisitions and copyright.
- Personnel salaries.
- Film and videotape.
- Materials production.
- Office materials and supplies.
- Student materials.
- Testing and evaluation materials.

4.3.6.3 Instructional Delivery Costs

- Instructors, tutors, teacher aides.
- Site operations and caretaking.
- Exam administration, scoring and reporting.
- Telephone and travel.
- Program evaluation.
- Student registration and counselling.

4.3.6.4 Administrative Costs

- Personnel Recruitment.
- Project meetings.
- Training sessions.
- Travel and telephone.
- Accommodation and meals.
- Project evaluation.
- Student recruitment.
- Public relations.
- Project documentation and reporting.
- Secretarial and support services.
- Computing services.
- Financial services.
- Library services.
- Inventory and warehousing.

A useful technique is to develop the budget based on project phases. For example:

Phase 1: Planning
Phase 2: Pre-operations
- Systems development
- Program development

Phase 3: Operational
- Program delivery
- Program evaluation
- Revisions and development

Phase 4: Post-operations

Finally, if when the budget is complete, cost-effectiveness or cost-benefit projections indicate little chance of the project meeting defensible levels of expenditure, the project should either be redesigned or terminated.

5 A Model For The Future Use of Satellites In Canadian Education

The prime purpose of our overall evaluation of this first major series of experiments on the use of satellites in education in Canada was to identify the elements of a model for the educational application of this telecommunications technology in the future. This section of the report addresses this task.

It is unnecessary to dwell on the difficulties of such model-building. While the Hermes experiments have given an indication of what some Canadian educators consider useful applications of satellite communication and revealed a few of the strengths and weaknesses of satellite systems, a model for future satellite use must appeal to a series of assumptions about social and technological trends. We shall begin by making these assumptions explicit.

5.1 Current Trends

5.1.1 Technological Trends

We believe that the world's satellite communication capacity will continue to expand steadily. Despite the limit on the number of orbital parking spaces available for geosynchronous satellites above the equator, developments in satellite size made possible by the space shuttle and the continued refinement of multiple accessing techniques which allow more efficient use of bandwidth will ensure that there is ample satellite communication capacity for the next twenty years. However, since bandwidth is a finite resource the steep fall in the costs of satellite communication circuits over the last decade will not continue indefinitely. During the period of the Hermes experiment it was assumed that the technological cost of a satellite transponder carrying one colour video channel was about $1,000 per hour. We shall assume that future developments will not cut this figure by more than 50%.

Much more substantial economies are to be expected in the earth segment as volume production of satellite ground terminals gets underway. Receive-only video terminals are already on the market for $4,000 and adaptors allowing direct satellite reception by individual homes could soon be produced in volume for a few hundred dollars each. Both for technical reasons and because of the relative sizes of potential markets it is likely that, with the exception of two-way data transmission terminals, prices of receive-only terminals will fall much faster than prices of terminals with transmission capabilities, whether sound or video.

Naturally, developments in technologies other than satellites will have an impact on the educational use of satellites. The microprocessor revolution is gathering speed and may allow computing technology to at last play the major role in education that has long been forecast for it. Videorecorders are also becoming more widespread so that in ten years time many Canadian homes will be able to record programs off air for viewing at their convenience.

5.1.2 Political and Economic Trends

There are signs, in the aftermath of California's proposition 13, that the free world is moving into an era in which the role of governments will be reduced. As a corollary to the diminution of government budgets we are likely to see the privatization of certain services currently provided by the state and a trend to deregulation. These changes will further increase the choice of goods, services and lifestyles available to people.

This expansion of choice will be especially marked in education. Even 'open' universities and other non-formal institutions in the public sector will feel the competition as private agencies provide an increasing range of flexible and well designed programs and courses.

5.1.3 Regulatory Trends

At present communications regulations constitute a greater obstacle to would-be satellite users than the costs of the technology. A rule that only Telesat Canada can own earth stations has the effect of artificially inflating the costs of using satellite ground terminals. Similarly Telesat's policy fixing the minimum period for transponder rental at one year effectively eliminates all but the largest users.

Happily both these policies have been under review by the federal government for some time and hopefully both these restraints on satellite use will be removed. However, the regulation of Canadian telecommunications by the CRTC is a complex issue and it is not obvious that in other areas a general trend towards deregulation will be to the advantage of educational users of satellites. Telesat is now a part of the Trans Canada Telephone System (TCTS) and a major preoccupation of this system must inevitably be to protect its investment in terrestrial facilities. Since even a totally open telecommunications market in Canada would be unlikely to promote much competition for TCTS apart from a few 'cream-skimming' enterprises, the continuance of the CRTC's watchdog role is desirable.

5.2 Elements of a Model

In this attempt at a model we shall consider only the operational use of satellites. The experimental use of satellites, like the projects described elsewhere in this report, may be a necessary, even a desirable step on the way to operational use. However, unless the way to operational use is clear such experiments can only generate frustration.

5.2.1 Payment of Costs

A feature of operational satellite systems is that users pay for the costs of operating the system. In an era when governmental involvement in providing services of all kinds is likely to decrease, we may expect that public and para-public agencies wishing to use satellites will be required to pay the costs incurred. These costs can be divided into three headings:

1. Space and system costs, i.e. rental of transponders and management of access to them (scheduling of programming).
2. Earth segment costs, i.e. purchase (or rental) and maintenance of ground stations.

3. Programming costs e.g. instructional costs, TV production costs.

Since programming costs are largely independent of the decision to use satellites (rather than e.g. a terrestrial UHF network) to deliver programs, we shall concentrate on the space and earth segment costs.

A study of these costs for two hypothetical Canadian educational satellite networks, was conducted in 1977 (Daniel). The results of that study are a major consideration in predicting a model for future educational use of satellites and lead to two preliminary hypotheses:

1. Most educational applications of satellites will employ video bandwidth. Although narrow-band applications are usually more cost-effective there is little sign that narrow-band communications (e.g. audioconferencing) are catching on in Canadian education. Furthermore, except for very intensive use and large distances (over 1000 km), satellites are not competitive with terrestrial facilities for such applications.
2. A cost of $1,000 per hour per colour video channel is an appropriate figure to use for the space cost (transponder rental).

The immediate implication of these hypotheses is that any educational activity carried by satellite should have a value of at least $1,000 per hour to its sponsors and participants. Few of the activities which made up the Hermes experiments would pass this test. Indeed, apart from the Public Service Commission experimenters who completely ignored space and earth segment costs in asserting their project to be cost-effective, the other experimenters all admit that the applications they tested would have difficulty surviving cost-benefit analyses for an operational system.

The primary reason that the benefits of the experiments rarely totalled $1,000 per hour was that so few people were involved. Hence alternative ways of creating a similar educational event (e.g. by travel to a central point) usually appeared cheaper.

To a degree the small numbers of participants were an artefact of the experiments themselves. Since few ground terminals were available each experiment involved few sites. There was thus no opportunity to aggregate the particular interest group involved (e.g. physicians) over a large number of sites to make up a large audience.

However, as well as the constraint imposed by the number of terminals available the experimenters' commitment to interactive communication also acted to diminish the number of participants. While there can be some discussion of the exact group size at which interaction ceases to be feasible the critical size numbers tens rather than hundreds.

This highlights the essential paradox posed by the Hermes experiments. Whether their conclusions resulted from self-fulfilling prophecies or not, experimenters maintain that for educational purposes satellite communication links should be both video and interactive (or at least have the possibility of incorporating these features when required). Yet we see that from an economic point of view these requirements work against each other. Interaction, as well as limiting the optimal number of participants, increases the earth segment and operator costs with the result that this type of video exchange carries a price which makes it more appropriate for discussions between heads of state and captains of industry than for the more humdrum requirements of adult and continuing education.

Scientific studies (a description which the Hermes experiments did not claim) have shown that for nearly all purposes a video signal does not add anything to the efficiency of interaction via audio. Unfortunately, probably because these results are counter-intuitive, they are either denied or ignored. Despite energetic proselytizing by the Department of Communications there has, in general, been little interest shown in Canada in the creation of operational audioconferencing systems. This may change now that TCTS has begun to promote this service to both the business and educational sectors. However, since audio-conferences can usually be set up more cheaply in Canada on terrestrial facilities than via satellite we shall not explore this application further.

5.3 Types of Satellite Use in Education

We suggest that the prime use of satellites in Canadian education will be for the delivery of TV programs in a uni-directional mode. This use will not preclude the occasional use of interactive video or of one way video with two way audio. However, we maintain that these more exotic uses will not even be possible unless satellite communication becomes a routine component of the educational scene. Delivery of video signals is the only activity likely to generate the traffic that would sustain an operational satellite network for education.

Canadian educational institutions, particularly universities, are making increasing use of the educational cable TV channels which are set aside by CRTC regulation on Canadian cable TV systems. It is worth noting that this development, which has been particularly marked during 1978/79, is being funded largely by the institutions themselves.

A useful distinction can be made between live and canned educational TV programs broadcast by satellite. Canned programs, often produced by institutions in other parts of the country or abroad, will probably be the mainstay of course-related TV since they enable repetition of programs term after term. However there is likely to be a significant volume of live courses for large interest groups or for professionals who are prepared to pay for continuing education on up-to-the-minute issues. To a degree the course production expenses of live programming will compensate for the cost of satellite delivery. Although some of these live programmes will no doubt encourage the audience to talk back we predict that this interaction will use the public switched telephone network and not involve the satellite directly.

In summary we believe that uni-directional TV delivery will provide the baseload of educational traffic on Canadian satellites. Although audio applications would often be more cost-effective we believe that the volume of these will remain low and that projects of this type will, in general, use the telephone network.

5.4 Political and Jurisdictional Issues

Experience shows that accessible and cost-effective communications facilities and channels will usually be put to work, even if the habit takes some time to catch on. To a considerable degree the use of satellites in education in Canada will depend less on cost than on the existence of a suitable legislative and organizational framework. Because of the many agencies and jurisdictions involved, Canada has already developed a fascinating diversity of structures for the management of educational communications and it should not be impossible to devise appropriate conditions for the educational use of satellites. The following considerations are simply meant as a basis for discussion.

5.4.1 Legislated Access

Canadian legislation requires that operators of cable TV systems set aside a channel for educational purposes. We suggest that satellite operators (Telesat and TCTS) be required to allocate some transponder capacity for educational purposes in a similar manner. This need not imply that such a channel be provided free; simply that it be available for education at cost.

5.4.2 Ground Operations

Having transponders available is of no use unless educational institutions can access a properly maintained network of ground terminals in the region they wish to serve. The provincial educational media corporations (ACCESS, Radio Quebec, OECA, etc.) have the stability, technical expertise, and geographical distribution to provide this support in the different provinces. They are also already part of the educational system in their provinces.

5.4.3 Scheduling and Management

In this area arrangements may well vary from province to province. Where the provincial educational media corporation is essentially a self-contained broadcasting operation it will probably be necessary to place the scheduling and management of access to educational satellite time in the hands of an agency or authority with a more general mandate. Two examples will suffice. In Quebec the operation of the ground terminals might be contracted to Radio-Quebec while scheduling might be the responsibility of the Department of Education's Service général des moyens d'enseignement (SGME). In Alberta the corresponding agencies might be ACCESS and the Alberta Educational Communications Authority.

Each designated provincial scheduling agency would negotiate with Telesat/TCTS for the time required. To some extent time zones would stagger demand for particular time slots although the government of Canada would probably need to provide guidelines for the division of satellite time between different regions of the country.

These suggestions may appear unduly simplistic given the long history of jurisdictional conflict in Canada over communications. However, we believe that it should be rather easy to avoid such conflicts in educational communications via satellite. The satellites are clearly a national resource which the federal government makes available to the country, whereas ground equipment for using the satellites in education is best operated by provincial agencies.

6 Conclusion

Evaluating the educational experiments conducted on the Hermes satellite in 1976/77 was a rewarding and fascinating experience. We believe that the allocation of satellite time, equipment and resources to these experiments was a useful investment by Canadian governments and institutions in the future of educational communications in the country.

Although we found much of value in the projects and admired the dedication and imagination of the experimenters, we do not believe that the experiments which were conducted are a guide to the future use of operational satellite systems by Canadian educators. In particular, we conclude that cost considerations will oblige institutions to use satellites to serve larger groups than were feasible in the Hermes experiments. This in turn will lead to a reduced emphasis on interactive communication.

Some of the Hermes projects linked the satellite to existing cable TV systems and we see such links as an important feature in the operational use of satellites in education. Although we agree that interactive narrow-band communications are more cost-effective than broad-band links for most educational purposes we predict that the delivery of live or canned TV programs will constitute the main educational traffic on Canadian satellites. With the gradual spread of home video-recording facilities and the rapid development of distant study opportunities we believe that this application will provide a valuable expansion of educational opportunities for the country's citizens.

Like the previous developments in communications which have built Canada, educational communications by satellite will need to be facilitated by the federal and provincial governments. We have made some suggestions for the organization of satellite use in education and believe that in this area the jurisdictional squabbles which have too often marked communications developments in Canada in the past can be avoided.

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EVALUATION DES EXPERIENCES EDUCATIVES REALISEES AU CANADA AVEC LE SATELLITE HERMES

1976-77

RAPPORT FINAL

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SOMMAIRE

La version anglaise de ce rapport décrit en détail l'évaluation des expériences éducatives qui ont été réalisées, grâce au satellite Hermès, par quatre institutions canadiennes au cours de l'année 1976-77.

Le premier chapitre (pp 1-2) résume les caractéristiques du satellite Hermès et les objectifs globaux du projet.

Dans le deuxième chapitre nous décrivons le cadre général de l'évaluation des experiences éducatives. Notre équipe a proposé aux expérimentateurs un modèle d'évaluation, inspiré des travaux de Stufflebeam, qui examine successivement le context du projet, les ressources utilisées, le déroulement des expériences et les résultats obtenus (pp 3,6-11). Nous insistons sur la complexité du processus évaluatif. Dans la mesure où chaque expérience a été analysée à plusieurs niveaux par des groupes ayant des préoccupations différentes, le projet Hermès a donné lieu à une documentation riche et abondante (pp 4-5, 11-16).

Le troisième chapitre décrit chacune des expériences et présente les résultats de l'évaluation. Dans chaque cas nous analysons les objectifs de l'évaluation et les résultats obtenus avant d'essayer de placer l'expérience dans le contexte de l'ensemble du projet Hermès et des télécommunications.

La section 3.1 (pp 17-45) est consacrée à l'expérience 'Réseau Omnibus' de l'université du Québec. Après avoir présenté le contexte, la genèse et une description du projet (pp 17-27) nous analysons (pp 27-33) les buts évaluatifs poursuivis par les divers intervenants. Ensuite nous résumons les conclusions tirées de chacune des sous-expériences (pp 33-36) avant de regarder l'expérience dans son ensemble (pp 36-42). Enfin, dans une perspective d'avenir, nous faisons quelques commentaires sur le développement de la formation à distance et sur les différentes façons de mettre la technologie des télécommunications au service de l'enseignement universitaire (pp 42-45).

Un format semblable est employé à la section 3.2 pour présenter l'expérience de télé-médecine de l'université Memorial. Pionnier de l'enseignement hors campus, cette institution préparait son projet Hermès depuis 1972 (pp 46-50). Après une longue évolution, l'expérience réalisée au printemps de 1977 était fondée sur l'éducation médicale permanente (pp 50-53). L'évaluation de l'expérience, ayant évolué parallèlement au projet, cherchait à analyser l'implantation d'une innovation sociale par une méthodologie fondée sur des entrevues (pp 53-58). Les résultats indiquent que le projet a été bien accueilli par les participants dont les perceptions rejoignaient, à certains égards, celles des participants québecois (pp 58-65). Enfin, nous présentons (pp 66-67) les conclusions de l'équipe terreneuvienne qui, tout en remarquant que l'évaluation économique du projet n'est pas concluante, fait une série de recommandations pour des expériences futures.

Le projet des universités de Carleton et de Stanford (pp 68-89) était à la fois une expérience technique et éducative. Ce projet a également connu des modifications considérables au cours de son évolution. De plus une panne du satellite Hermès qui a retardé la réalisation de l'expérience, a créé de graves problèmes (pp 68-76). L'évaluation du projet a porté une attention particulière aux aspects administratifs. Même si le succès global du projet a été relativement modeste, l'innovation technique de compression digitale des images video a été bien réussi et l'on a démontré qu'il est possible d'employer le satellite pour échanger des cours avancés entre deux universités (pp 76-89).

Les pages 89 - 107 présentent l'expérience de la Commission de la Fonction publique. A la différence des autres projets, cette expérience a été conçue de façon scientifique afin de vérifier certaines hypothèses relatives à la méthodologie pédagogique employée. Le projet, qui reliait Ottawa à St. Jean, Terre neuve, consistait en un cours sur la planification a long terme (pp 89-100). L'on a démontré que les cours par satellite permettent un apprentissage aussi efficace que les cours traditionnels et que, si l'on ne tient pas compte des coûts du satellite, une analyse coût-bénéfice favorise les cours par satellite (pp 101-109).

Au chapitre 4 nous examinons le projet Hermès dans son ensemble. Tout d'abord, nous indiquons comment, dans les différents projets, l'on a réussi l'institutionalisation d'une nouvelle technologie (pp 108-113). Ensuite nous tachons d'évaluer la signification éducative de cette première série d'expériences par satellite (pp 113-117). Enfin nous examinons les considérations administratives inhérentes à ce genre de projet (pp 117-123).

Dans le cinquième chapitre nous esquissons, à partir des leçons du projet Hermès et des tendances technologiques et socio-politiques actuelles, un modèle pour l'utilisation des satellites en éducation au Canada à l'avenir (pp 123-132). Nous suggérons que, pour les raisons de coûts, l'utilisation des satellites pour la diffusion uni-directionnelle des images télévisuelles sera plus frequente que leur utilisation pour des échanges interactifs du type Hermès. Afin de faciliter l'utilisation des satellites en éducation nous proposons que, par législation, une certaine largueur de bande sur le réseau canadien de satellites soit réservée aux communications éducatives. Le maintien du réseau de terminaux terrestres serait alors assuré par les agences provinciales compétentes (pp 126-132).

Enfin, dans un dernier chapitre, nous constatous que le projet Hermès a été un évènement important dans l'évolution de l'éducation au Canada. Même si l'utilisation operationnelle des satellites privilégie des applications éducatives autres que celles que nous avons vues dans les expériences Hermès, cette série de projets aura joué un rôle important.